

The *Aristotelian* Problemata Physica

PHILOSOPHICAL AND
SCIENTIFIC INVESTIGATIONS

EDITED BY
ROBERT MAYHEW

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The Aristotelian *Problemata Physica*

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The Aristotelian *Problemata Physica*

Philosophical and Scientific Investigations

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Robert Mayhew



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Editor's Preface

The *Problemata physica* is the third longest work in the *corpus Aristotelicum*, but among the least studied. While working on a new Loeb Classical Library edition of the *Problemata*, I became more convinced than ever that this long-neglected work merited further study, as it has much to tell us about the specific nature of philosophical and scientific inquiry in the Lyceum during Aristotle's life and especially in the years following his death.¹

The *Problemata* consists of thirty-eight books, and over nine hundred chapters. There is a rough order of presentation of these books (more on this shortly), though the chapters within each book are almost always presented in no particular order. Nearly all of these chapters begin with a question—and specifically with the words διὰ τί ('why?' or 'on account of what?')—followed by one or more (often provisional) answers and/or follow-up questions. The range of subjects covered is vast and varied: medicine and music, sex and salt water, fatigue and fruit, animals and astronomy, moderation and malodorous things, wind and wine, bruises and barley, voice and virtue, etc. A single volume collection of essays covering all thirty-eight books and most of the topics explored in them is likely not possible. Most of the major sections of the *Problemata* are covered, however, and this collection does a great deal to remedy the general neglect of this work.

Of the twenty-one essays in this collection, the first three provide an introduction to and overview of the *Problemata*, as well as much of the context necessary for understanding it (and they obviate the need for me to say more

¹ There are important exceptions to this neglect: H. Flashar, *Aristoteles: Problemata Physica* (Berlin: Akademie-Verlag, 1962; 4th ed., 1991); P. Louis, *Aristote: Problèmes*, 3 vols. (Paris: Les Belles Lettres, 1991–94); B. Centrone, ed., *Studi sui Problemata Physica Aristotelici* (Naples: Bibliopolis, 2011). Still useful is E.S. Forster's heavily annotated translation of the *Problemata* in *The Works of Aristotle Translated into English Under the Editorship of W.D. Ross*, vol. 7 (Oxford: Oxford University Press, 1927). G. Marengi has produced a number of volumes containing text and translation of parts of the *Problemata*, based on a careful study of the manuscripts: *Aristotele: Problemi di Musicali* (Florence: Fussi, 1957); *Aristotele: Problemi di Fonazione e di Acustica* (Naples: Libreria Scientifica, 1962); *Aristotele: Problemi di Medicina*, rev. ed. (Milan: Massari, 1999); [*Aristotele*]: *Profumi e Miasmi* (Naples: Arte Tipografica, 1991). Note that the books on music (11 & 19) and the chapter on melancholy (30.1) have not been as neglected as the rest. (See Flashar's commentary on these books and this chapter for further details.)

in this preface about its nature):² István Bodnár's "The *Problemata physica*: An Introduction"; Stephen Menn's "Democritus, Aristotle, and the *Problemata*"; and, James G. Lennox's "Aristotle's *Posterior Analytics* and the Aristotelian *Problemata*."

With the exception of the last chapter, each of the remaining essays focuses on some book(s) or chapter of the *Problemata*, and their appearance in this volume follows the order of that work. The first nine books (give or take) are on medicine and human physiology,³ and three essays are devoted to all or part of this section of the work: Katerina Oikonomopoulou's "The *Problemata*'s Medical Books: Structural and Methodological Aspects";⁴ Oliver Thomas's "Creating *Problemata* with the Hippocratic Corpus"; and, William W. Fortenbaugh's "On *Problemata* 3: Wine-Drinking and Drunkenness."

Books 10–19 deal with miscellaneous subjects, though within this fairly random grouping some books have clearly been placed together for a reason. The subject matter of the longest book (10), despite the absence of any reference to animals in its title,⁵ is biology. This material is covered by Byron J. Stoyles's "Material and Teleological Explanations in *Problemata* 10." Books 11 (on voice) and 19 (on *harmonia*) are often treated together, as they both deal with aspects of music. Each is the subject of an essay in this volume:⁶ Stefan Hagel's "Sound Reasoning in *Problemata* 11? Disentangling the Components of Voices," and Andrew Barker's "Musical Pitch and the Enigmatic Octave in *Problemata* 19." Books 12–13, on good odors and bad odors respectively, are the subject of Han Baltussen's "Understanding Odours in *Problemata* 12–13: Peripatetic Problems Concerning the Elusive Sense of Smell." Two other essays each focus on an individual book from this miscellaneous set: Mariska Leunissen's

2 But see my introduction to the *Problemata* in R. Mayhew, *Aristotle: Problems*, vol. 1: *Books 1–19* (Cambridge, MA: Harvard University Press, 2011): xiii–xxiv.

3 Re. "give or take": This depends on who you ask. Marengi's *Aristotele: Problemi di Medicina* (see n. 1) contains Books 1, 6–9, 14, 27–28, 31–38. Philip van der Eijk, "Between the Hippocratics and the Alexandrians: Medicine, Philosophy and Science in the Fourth Century BCE," in R.W. Sharples, ed., *Philosophy and the Sciences in Antiquity* (Aldershot, UK: Ashgate, 2005), includes in his list of medical works Books 1–9 and 31–38. And see the following note.

4 As Katerina Oikonomopoulou's conception of what counts as a medical book extends well beyond the first nine (she includes 1–11 and 31–38), her essay is in fact transitional between those providing an overview of the background, nature, and methodology of the *Problemata* as a whole, and those focusing on books 1–9. The same could be said of Oliver Thomas's essay.

5 *Epitome of Natural Problems* or *Epitome of Natural Things* (Ἐπιτομή φυσικῶν).

6 I mention them together here, though their appearance in the volume follows the order of the *Problemata*.

"The Ethnography of *Problemata* 14 in (Its Mostly Aristotelian) Context," and Alan C. Bowen's "*Problemata* 15: Its Title and Agenda."

Books 20–22 were grouped together because they all deal in some sense with plants—particularly as sources of nutrition. John Wilkins discusses the content of two of these books in "Food and Health in *Problemata* 21–22: Cooking (*pepsis*) in the Kitchen and 'Cooking' (*pepsis*) in the Body." Meteorological problems are treated in books 23–26, two of which are the subject of the following essays: Malcolm Wilson's "On *Problemata* 23: Little Problems on the Vast Sea," and my "*Problemata* 26 and Theophrastus' *De ventis*: A Preliminary Comparison."

Books 27–30 are devoted to moral philosophy, and particularly to issues (often physiological) associated with the major virtues and related states of the soul. They are covered by five essays: William W. Fortenbaugh's "On *Problemata* 27: Problems Connected with Fear and Courage"; Bruno Centrone's "On *Problemata* 28: Temperance and Intemperance, Continence and Incontinence"; David C. Mirhady's "*Problemata* 29 and Athenian Law"; Eckart Schütrumpf's "Black Bile as the Cause of Human Accomplishments and Behaviors in *Problemata* 30.1: Is the Concept Aristotelian?"; and, Jason G. Rheins's "*Homo numerans, venerans, or imitans?* Human and Animal Cognition in *Problemata* 30.6."

The *Problemata physica* ends with a set of brief books (31–38) on human anatomy. None of these is the subject of an individual essay in this collection; but as they fall under the purview of Katerina Oikonomopoulou's and Oliver Thomas's essays, they receive general coverage there.

Although the focus of this collection was by design on the content of the *Problemata* and not on its influence or afterlife,⁷ I wanted to end the volume with one essay that locates the *Problemata* in the context of texts of the same sort in later antiquity: this aim is served by Liba Taub's "'Problematising' the *Problemata*: The *Problemata* in Relation to Other Question-and-Answer Texts."

Jonathan Barnes ends his study of Aspasius' commentary on the *Nicomachean Ethics*: "Since it is customary to round things off with a final banality, here is one: Aspasius has baked a dry pie—but a probing thumb will pull out a plum or

7 On the influence and reception of the *Problemata*, up to and including the Renaissance, see Peter De Leemans and Michèle Goyens eds., *Aristotle's Problemata in Different Times and Tongues* (Leuven: Leuven University Press, 2006).

two.”⁸ If I may borrow Barnes’s analogy: The *Problemata* is not one Peripatetic pie, but thirty-eight, and historically they have not been to everyone’s liking. Some are dry, some strange, and some quite surprising. The essays in this collection present the results of a great deal of probing, and to my mind demonstrate that the *Problemata* is not just worth a taste but (here I drop the analogy) deserves greater appreciation and further investigation.⁹

8 “An Introduction to Aspasius,” in *Aspasius: The Earliest Extant Commentary on Aristotle’s Ethics*, edited by Antonina Alberti and Robert W. Sharples, 1–50 (Berlin: de Gruyter, 1999): 50.

9 I would like to thank a number of the contributors and an anonymous reviewer for comments that improved this preface.

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Abbreviations

Aristotle (Arist.) & the *Corpus Aristotelicum*

<i>APo.</i>	<i>Analytica posteriora</i>
<i>APr.</i>	<i>Analytica priora</i>
<i>Ath.Po.</i>	<i>Athenaion politeia</i>
<i>Aud.</i>	<i>De audibilibus</i>
<i>Cael.</i>	<i>De caelo</i>
<i>Cat.</i>	<i>Categoriae</i>
<i>Col.</i>	<i>De coloribus</i>
<i>DA</i>	<i>De anima</i>
<i>Div.Somn.</i>	<i>De divinatione per somnum</i>
<i>EE</i>	<i>Ethica Eudemia</i>
<i>EN</i>	<i>Ethica Nicomachea</i>
<i>GA</i>	<i>De generatione animalium</i>
<i>GC</i>	<i>De generatione et corruptione</i>
<i>HA</i>	<i>Historia animalium</i>
<i>IA</i>	<i>De incessu animalium</i>
<i>Insomn.</i>	<i>De insomniis</i>
<i>Inun. Nili</i>	<i>De inundatione Nili</i>
<i>Juv.</i>	<i>De juventute</i>
<i>Long.</i>	<i>De longaeuitate</i>
<i>MA</i>	<i>De motu animalium</i>
<i>MM</i>	<i>Magna moralia</i>
<i>Mech.</i>	<i>Mechanica</i>
<i>Mem.</i>	<i>De memoria</i>
<i>Metaph.</i>	<i>Metaphysica</i>
<i>Mete.</i>	<i>Meteorologica</i>
<i>Mir.</i>	<i>De mirabilibus auscultationibus</i>
<i>PA</i>	<i>De partibus animalium</i>
<i>Phgn.</i>	<i>Physiognomonica</i>
<i>Phys.</i>	<i>Physica</i>
<i>Poet.</i>	<i>Poetica</i>
<i>Pol.</i>	<i>Politica</i>
<i>Pr.</i>	<i>Problemata</i>
<i>Resp.</i>	<i>De respiratione</i>
<i>Rhet.</i>	<i>Rhetorica</i>
<i>Rh.AL.</i>	<i>Rhetorica ad Alexandrum</i>

<i>SE</i>	<i>Sophistici elenchi</i>
<i>Sens.</i>	<i>De sensu</i>
<i>Somn.</i>	<i>De somno et vigilia</i>
<i>Top.</i>	<i>Topica</i>

Theophrastus (Thphr.)

<i>CP</i>	<i>De causis plantarum</i>
<i>HP</i>	<i>Historia plantarum</i>
<i>Lap.</i>	<i>De lapidibus</i>
<i>Lass.</i>	<i>De lassitudine</i>
<i>Od.</i>	<i>De odoribus</i>
<i>Sens.</i>	<i>De sensu</i>
<i>Sign.</i>	<i>De signis</i>
<i>Sud.</i>	<i>De sudore</i>
<i>Vent.</i>	<i>De ventis</i>
<i>Vert.</i>	<i>De vertigine</i>

(See below on FHS&G)

For other ancient authors and works, we have where possible used the abbreviations in LSJ (see below) and/or in S. Hornblower and A. Spawforth eds., *The Oxford Classical Dictionary*, 3rd ed. (Oxford: Oxford University Press, 2003). For the works of Galen, we have used the abbreviations in the appendix—"A Guide to the Editions and Abbreviations of the Galenic Corpus"—in R.J. Hankinson ed., *The Cambridge Companion to Galen* (Cambridge: Cambridge University Press, 2008).

Abbreviations of modern works:

DK	H. Diels and W. Kranz., eds. <i>Die Fragmente der Vorsokratiker</i> , 6th ed. Berlin: Weidmann, 1952
FHS&G	William W. Fortenbaugh, Pamela M. Huby, Robert W. Sharples, and Dmitri Gutas, eds., <i>Theophrastus of Eresus: Sources for his Life, Writings, Thought & Influence</i> , 2 vols. Leiden: Brill, 1992
Gigon	Olof Gigon, <i>Aristotelis opera, volumen tertium: Librorum deperditorum fragmenta</i> . Berlin: Walter de Gruyter, 1987
Kühn	C.G. Kühn, <i>Galen Opera Omnia</i> , 20 vols. Leipzig: C. Knobloch, 1819–33
LSJ	H.G. Liddell, R. Scott, and H.S. Jones, eds. <i>Greek-English Lexicon</i> , rev. 9th ed. Oxford: Oxford University Press, 1996

- PPA *Problemata Physica Arabica*. In L.S. Filius, *The Problemata Physica attributed to Aristotle: The Arabic Version of Hunain ibn Ishāq and the Hebrew Version of Moses ibn Tibbon*. Leiden: Brill. 1999
- Rose³ Valentin Rose, *Aristotelis qui ferebantur librorum fragmenta*. Leipzig: Teubner, 1886. (This is not actually a third edition of the same work, but Rose's third attempt at or version of a collection of the 'fragments' of Aristotle.)
- TLG *Thesaurus Linguae Graecae* (www.tlg.uci.edu)

The *Problemata physica*: An Introduction¹

István Bodnár

Aristotle on several occasions refers to further discussion of issues in “the problems.” Nevertheless, with one exception, these indications cannot possibly refer to the contents of the *Problemata* (or *Problemata physica*) in the Aristotelian corpus. That work is apparently a Peripatetic compilation, often dependent on Theophrastan and even later material.

Although this collection as such does not have Aristotelian provenance, not only does the practice of setting up collections of problems go back to Aristotle and his predecessors, we also find in Aristotle theoretical discussions about the presuppositions of the problems themselves, and the different uses they can be set to.

1 Aristotle on Problems

Aristotle in the *Topics* sets out what a *dialectical problem* (πρόβλημα διαλεκτικόν) is. Such a problem differs from what Aristotle calls a dialectical proposition/premise (πρότασις διαλεκτική) in formulation and in purpose. Dialectical proposition/premises and dialectical problems alike need to set out issues relevant for discussion. These should neither be evidently true or evidently false, nor immediately demonstrable, moreover they should not require a too lengthy demonstration—these would make them inappropriate topics for discussion (105a7–9). The propositions/premises and the problems differ in their formulation (101b28–36), and this corresponds to the different role propositions/premises perform on the one hand and problems perform on the other. Premises/propositions request statements *from which* argumentations are derived, whereas deductive inferences are *about* problems (101b13–16).

Some such dialectical propositions/premises may be readily available. But, Aristotle adds, written works need also to be culled for such dialectical propositions/premises, and for every *genos* separate lists of propositions/premises

¹ This chapter is a slightly modified version of part of an essay that appeared in German in Rapp and Corcilius (2011).

need to be drawn up. These lists should cover the *genos* in question in its full generality and they should be set out in a systematic manner: they have to start with an account of what each particular kind is—what is good, or what is animal—and then proceed to further issues about these, also indicating which opinion was held by whom (105b12–17).

Clearly, these lists need not adhere to the *Topics*' canonical formulations of dialectical propositions/premises on the one hand, and of dialectical problems on the other. Rather, they will indicate the relevant opinions about some subject matter, and these can be converted into the format of dialectical propositions/premises, or into the format of dialectical problems. Furthermore, Aristotle stresses that such collections can be used not only in dialectical debate: they can also be treated in a scientific manner (πρὸς φιλοσοφίαν), according to truth (105b30–31). That is to say, such lists of different views serve also the purposes of critical, scientific inquiry, e.g. for setting out material so often used by Aristotle at the starting point of his theoretical discussions, critically evaluating the opinions of his predecessors.

Besides the contents of all these variegated collections of propositions/premises, there is a further specific kind of problems, the so-called *physical problems*. These, as Aristotle submitted in *On Problems* (Περὶ προβλημάτων, fr. 112 Rose³ = Alex.Aphr. in *Top.* p. 63 Wallies), concern cases where the cause of something is not known. Accordingly, they are formulated in terms of why (διὰ τί) questions, or they ask for the definition of what (τί) something is.²

Why questions can also give rise to lists collecting what kind of explanation different authorities gave. A famous example for such a work is Aristotle's *On the Flood of the Nile* (frs. 246, 247, and 248 Rose³; see Aubert 2014). This lost work of three books features on two of the ancient catalogues of Aristotle. We possess a very short, mediaeval Latin translation, which ultimately may go back to Aristotle's original work. But even if this Latin translation went back to extracts from a later, pseudo-Aristotelian work, the format of this short collection of explanations should be roughly the same as that of the original Aristotelian one. Moreover, the final section of the Latin collection is strikingly in accordance with what is submitted about physical problems in *On Problems*: "Now, only one cause of the reported facts is there left. This should be declared to be the cause, because it is apparently not a problem any longer. For it has been experienced with senses, in a way in which people become eyewitnesses on the basis of what they see" (Aubert translation, slightly modified). That is

2 For a detailed discussion of issues of Aristotelian dialectics, theory of proof, and Aristotelian problems, see Lennox (1994) and Lennox's chapter in this volume.

to say, the fact that the cause of the summer floods of the Nile could be ascertained by some sort of direct evidence, made the old problem obsolete. It has become a problem of the past. Nevertheless, a work collecting the previous attempts at an explanation still tackles a physical problem, as it collects different attempts to uncover the cause of some phenomenon, and give an explanation for it in terms of its cause.

But collections of physical problems list not only previous answers. Indeed the collection of explanations of the floods of the Nile is rather close to the two extant specimens of collections of problems in the Aristotelian corpus, the *Problemata physica* and the *Mechanica*. Both of these works consist of a series of “Why” questions, which are followed by explanations, formulated again in terms of a rather tentative, or even timid answer, “Is it because . . . ?” (ἢ ὅτι . . .), or when several alternative explanations are being canvassed “Is it because . . . or is it because . . . ?” (πότερον ὅτι . . . ἢ ὅτι . . .). The answer is couched in a yes-or-no *question*, or a *question* listing different alternative explanations, although to this question no answer is expected. Nevertheless, it would be rash to infer that these works collect material for dialectical purposes. Instead, the interrogative format suggests that the inquiry initiated by the “Why” question is by no means closed in a definitive way. Needless to say this is often just a mannerism, a result of the format, rather than of what is propounded in the answer section. But on some occasions—especially where there are several, alternative answers proposed—the indecisiveness is genuine, and the question and its answer may be the record of actual, tentative research, or of some school-discussion, where the answers of the pupils to the question of the teacher are recorded.

Nevertheless, this is only so in the minority of cases. Most often what the tentative answers formulate in the *Problemata physica* and in the *Mechanica* are some standard answers current in the Peripatetic school. These collections can be, accordingly, much rather an alternative arrangement for the presentation of these standard answers—a sort of encyclopaedia, where one can quickly find the answers to their questions, without the need for in-depth study of the school treatises—than an investigative logbook which would be preparatory for further research.

2 Aristotle's Lost Problems

Aristotle's sparse references to the discussions of issues “in the problems” indicate that they included discussions of zoology, about the contrast between

dreams and what is done in sleep, about the winds, about metals and about the behaviour of stoked fire.³ This disparate material need not necessarily have belonged to a single work, or if it did, it certainly had some sort of an internal articulation. So the introductory lines at *Meteorology* 2.6.363a21–25, that all the properties of the winds will be discussed which have not been tackled “in the particular problems” (ἐν τοῖς προβλήμασιν . . . τοῖς κατὰ μέρος) suggest that in—or among—the *Problems* there was some section specifically dedicated to issues about the winds. Nevertheless it did not give an exhaustive and theoretically well-rounded, treatise-like discussion. Instead, the references suggest that even if there were overlaps between the issues discussed in the problems and in the treatises (for such an instance see *GA* 4.4.772b6–12), the problems did not cover everything discussed in the treatises, and contained to a significant extent material extraneous to the school-writings.

3 The *Problemata physica*

The extant *Problemata* (or *Problemata physica*, the title of the collection found in some of the manuscripts) contains almost 900 problems in thirty-eight books. Each book is a loosely organised collection of problems on a particular topic. These topics, as indicated in the titles of the books, can be quite large (to the extent that some of the book titles are not too informative, see e.g. *Pr.* 16: Problems about inanimate things, thirteen problems; 17: Problems about animate things, three problems, where both of these books collect mostly problems of applied mathematics), or they can be extremely specific (see e.g. 3: Problems about drinking wine and drunkenness, thirty-five problems; 4: Problems about sexual intercourse, thirty-two problems; 5: Problems from fatigue, forty-two problems; 21: Problems about barley-meal, barley-cake and similar things, twenty-six problems). The titles suggest that the books are exhaustive—they contain all the problems that are about something (ὅσα περὶ τινα, literally the multitude that are about something; or ὅσα ἔκ / ἀπό τινος, literally the multitude that derive from something; or, in the case of *Pr.* 15, the ones which partake of / are involved in mathematical theory, and the ones which are about celestial matters). The only book with a different title is 10: Epitome

3 For a full listing of Aristotle's references to his *Problemata*, see Flashar (1983, 303–307). See furthermore frs. 209–245 in Rose (1886) for ancient *testimonia* about *Problemata* attributed to Aristotle which however are not present in the *Problemata physica*.

of Physical Writings, which in this case refers to a collection of excerpts, in problem format, from Aristotle's biological writings.

Nevertheless, the standardized format of the titles and of the problems themselves does not guarantee that the contents of the individual books would be uniform. The individual books differ vastly in scope, and then in execution. Some of them, with a very broad topic contain only a few problems, whereas others can include a much larger number of problems. But even in these cases, the treatment of the topic need not by any means be systematic or exhaustive. Indeed, it is only in the case of very few books where we can speak about a more or less systematic discussion of the topic of the book. The prime examples of these "orderly" books are *Pr.* 1, 10, and 20 (where 1 is made up of two rather distinct parts, signalled in some of the manuscripts at 1.30: the first twenty-nine problems are about issues of illness, whereas the last twenty-eight problems are about the specific treatments for these maladies). The other books often contain duplicates, across different books, or even within the same book. Sometimes only the problem is repeated, verbatim, or somewhat rephrased, and another formulation of the same answer (or a different answer) is put forward in these duplicate problems (for a characteristic instance see *Pr.* 31, Problems connected with the eyes, chapters 12, 13, 18, and 29, on why there is no difference between the right and left sense organs, like the eyes, unlike e.g. the hands). But the duplicates may even be repetitions of the problem and the answer. When this occurs in two different books, or in different clusters of problems of the same book, what happens is that the collection includes the same problem as relevant to two different topics, because—rightly or wrongly—the problem is thought to bear on both issues (see e.g. *Pr.* 1.39 and 5.38, reformulations of Theophrastus' *On Fatigue* 13, on why fatigue is cured in the summer by baths, and in the winter by anointing—first in the second half of *Pr.* 1, on therapy, and then in 5, on fatigue).

The state of the collection of problems suggests several things. Most importantly, the topical headings of the books are not haphazard. The enterprise is in some sense encyclopaedic. Often adjacent books collect problems about related issues—so *Pr.* 1–9, about medical and physiological issues, 15–17, about problems of mathematics and applied mathematics, 20–22, about plants, 23–26, about water and air, 27–30 about the virtues (although the discussion in 29 of justice and injustice is mostly about jurisprudence), and 31–38, about parts of the body. Issues which would belong to collections of logical or ethical problems are seldom present, even the books on virtues approach their topics in a way which is most often connected to a discussion of emotions and physiology. All this suggests that even if we cannot get a handle on the actual

principles of collection, composition, and arrangement of these problems, they were not put together in a random way. We are not in a position to assess this process fully, but it is clear that there was some method in it.⁴

It is also clear that the collection, composition, and arrangement of this material could not have gone on indefinitely. Most importantly, the collection apparently does not include material from Alexander of Aphrodisias, or his school, whereas other collections include also later material besides some of the problems from our *Problemata physica* (see Sharples 2006, and Kapetanaki and Sharples 2006). Instead, the most conspicuous sources and influences are Aristotle himself, Theophrastus (in botany and in physiology), Strato of Lampsacus (in some discussions of problems of natural science), the Hippocratic treatises and Diocles of Carystus (on medicine), and Aristoxenus (in *Pr.* 19, on music).

As the list also suggests, the *Problemata* is not, indeed, presumably it does not even intend to be, a collection of a closed and systematic outlook. Even where an authority is used for tackling some issues, this does not need to extend to other problems of the same domain. Some problems (see especially *Pr.* 22.4) suggest that motion requires the presence of internal void. Most probably these explanations rest on Strato's arguments for the existence of such internal pockets of void. But the dependence on Strato is uneven. Both *Pr.* 11.33, when it submits that the rays of the sun are corporeal, and 25.18 in asserting the stars and the heaven are warm, presumably follow Stratonian doctrines (cf. furthermore 25.21, which after mentioning the opinion of "the men of old", οἱ ἀρχαῖοι, that the stars are cold, queries this as "thoroughly absurd," λίαν ἄτοπον). Nevertheless, a further signal innovation of Strato's, that all four elements have weight, and none of them has absolute lightness, is not carried through: when it comes to giving explanations about fire and air, the two elements which according to Aristotle have a natural tendency to move upwards, the *Problemata* sticks to this orthodox doctrine (see e.g. 25.13 and 14).

All this suggests that the *Problemata* does not intend to provide a set of authoritative solutions by a particular Peripatetic author or his closest disciples. Instead, the *Problemata* recasts the ongoing literary activity, from Aristotle on, around the issues included here, where different sources, sometimes advocating different, or even contradictory positions are combined in a way that may not give fully justice to these positions. Moreover, it should also be stressed that the *Problemata* does not cover the discussions within the school in an extensive manner. Significant innovations or contentions may remain absent from the *Problemata*, to the extent that they are not even mentioned so as

4 For a detailed assessment of the case of the 'Medical Books' see Oikonomopoulou's chapter in this volume.

to be refuted. In some cases, on the other hand, such innovations are mentioned only in passing as a presupposition of some connected issue, without giving particular attention to the doctrinal debates involved. In this manner, e.g., *Pr.* 33.7 and 9 submit that the head is the seat of reasoning, and it is the best and most sacred part of the body, whereas when 30.1 refers to the place of the intellect (i.e. to the “intellectual place,” νοερὸς τόπος) or to “the region with which we hope and think” (τόπος ᾧ φρονούμεν καὶ ἐλπίζομεν) the context clearly suggests that these considerations are formulated with Aristotle’s cardiocentrism in mind. All in all, neither does the *Problemata* attempt to formulate a consistent and comprehensive account of the topics discussed, nor does it collect and assess all the possible answers to the issues discussed, not even the ones formulated in the Peripatos itself.

Although there is no such thing as *the* theoretical framework of the *Problemata*, some explanatory principles which are regularly used can be mentioned. Explanations often refer to the properties of some fundamental components—be they the four humors of the living body, or even more fundamental components, as the four elements, fire, air, water and earth. These explanatory properties are distributed into pairs of opposites. These opposites exert their active influence and undergo changes, respectively, on each other, and the outcome depends largely on which of them gains the upper hand.

Nevertheless, the explanations of the *Problemata* can be much more elaborate and sophisticated than such a bland description of the interaction of the opposites. First, the relevant explanatory property has to be found, as some outcomes are the result of the combined effects of different properties—melting, e.g. requires heat *and* rarity, or heat *and* the absence of water (*Pr.* 24.4). Then there are all sorts of issues about the configurations these properties are operative in. There can be all sorts of circumstances which facilitate or hinder these interactions. Most often structural features of the “environment” of the interaction need to be specified, as these features can have fundamental influence over what kind of interaction takes place, and what sort of outcome it will have. Even apart from these very variegated considerations, two explanatory patterns are deployed regularly to account for unexpected outcomes: “Fire on fire” (πῦρ ἐπὶ πῦρ) is the shorthand used for cases where two entities of the same characteristic—and not two entities of opposite characteristics—are in interaction. In these cases the action of a smaller quantity of fire, instead of being facilitated, is rather quenched by some larger quantity of fire. Such considerations can explain why excessive heat, or wine, which also contains warmth, causes us to tremble (3.5 and 26), why one should eat figs either with water, or with unmixed wine (22.8), i.e. how come that these two liquids, although water is cold, whereas wine has fire in it, have the same effect of extinguishing the fire in the fruit.

As a converse of such considerations there are the cases of *antiperistasis* or compression. These occur when one of the opposites is not destroyed by the action of the other, indeed it is reinforced as it is confined to a more circumscribed domain by the other. Such explanations are invoked all over the place in the *Problemata*: 3.26 submits that hot water causes goose bumps, because it encloses and compresses the cold (see also 24.13); 14.3 accounts for the fact that burning fevers occur with greater frequency in the cold season in a similar manner.

Such explanatory procedures give rise then to the more general query in *Pr.* 9.6—a problem which is not in the standard problem format!—whether when different entities have the same effect do they do so on account of some identical capacity all of them have, or not. The problem then goes on to provide an example, that bruises are removed by bronze, by radishes, by mashed bean or by sea lungs. These are effective on bruises on account of rather disparate characteristics: bronze because of the rust it has, whereas the other three because of their rarity, and indeed some other things can be effective on yet further, different characteristics. Then, as an alternative formulation of these examples as well, the problem closes by the statement that although in these cases the proximate, and in this sense ultimate causal factor, is the same, what precede these—presumably, the initiating causal factor and the way this is responsible for the presence of the same ultimate causal factor—can themselves be different. (See also 3.26.874b36–875a2, for a similar discussion of contrary causes of the same effects, and 9.9, 10, & 12 for further details about the use of different treatments for stopping bruises.)⁵

Such a summary characterisation, however, cannot do justice to the wealth of material occasionally included here. So, *Pr.* 19 is an invaluable source about musical theory, or 30.1, the little treatise about melancholy, provides a glimpse into the span of the applicability of considerations of humoral theory. Besides, the *Problemata*—as it is wont of Aristotelian or Peripatetic writings—contains a fair amount of testimonies of earlier authors: e.g., Anaxagoras (11.33, 16.8), Archytas (16.9), and Empedocles (14.14, 21.22, 24.11). Epicharmus is also quoted, although without name (11.33), and, quite unexpectedly, even a major discovery of Hipparchus is taken up when—in a discussion why people generally use the decimal system in counting (15.3)—the author of the problem submits that there are altogether nine moving celestial bodies. Presumably these nine together with the central, stationary earth make up a complete group of ten entities, but then besides the seven planets and the outermost heavenly

5 With this compare the description in the *Posterior Analytics* of the procedure of finding the proper explanatory factor, discussed in section 4 of Lennox's chapter in this volume.

sphere, Hipparchus' additional heavenly sphere, which accounts for the precession of the equinoxes, also needs to be included in the tally.

All this attests to the complex history and use of this collection, and to its unique relevance as a source book for the history and practice of Peripatetic natural philosophy. In closing, let me add two cautionary remarks about the status of this collection. One is that although—as stressed above—Aristotle's pointers to material in the “problems” does not refer to our collection, this does not exclude the presence of Aristotelian material elsewhere. A second important point to keep in mind is that the cases where there are textual or doctrinal parallels or similarities between an author and our *Problemata* need always to be assessed on a case by case basis. Although most often it can be assumed that the wording of the *Problemata* is secondary, that the individual problems derive from works of a different format or genre—just as Aristotle suggests that premises/propositions need to be culled from different authors and works—in principle it cannot be excluded that in some cases these issues had been formulated problem style prior to their being reworked, in more detail, in the more extended format of another genre.⁶

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6 I owe this latter caveat to Stephen Menn.

Democritus, Aristotle, and the *Problemata*

Stephen Menn¹

1 Aristotle's Problem-Works and Democritus

There might seem to be nothing to say on our topic, since Aristotle, or the Peripatetic authors whose work is collected in our thirty-eight books of *Problemata*, never mention Democritus in that treatise. On the other hand, the Hellenistic catalog of Aristotle's works, transmitted in slightly different forms in Diogenes Laertius and in the Anonymus Menagii, lists alongside a *Physics* [φυσικά] in 38 books which must be our *Problemata* (D.L. #120, Anon. #110) also two books of *Democritean Problems* (Anon. #116) or *Problems from the [Writings] of Democritus* (D.L. #124).² This might be dismissed as irrelevant to our *Problemata*: after all, Aristotle also wrote *Homeric Problems* (ten books, listed in the Anonymus' "appendix," #147, perhaps the same as the *Homeric Aporemata* in six books, D.L. #118, Anon. #106), and since *Homeric Problems* certainly have nothing do with our *Problemata*, why should *Democritean Problems* be any more relevant?

1 I would like to thank István Bodnár, Andrea Falcon, Robert Mayhew, and Katerina Oikonomopoulou for written comments, and Pieter Beullens and Jim Lennox for discussion, Pieter also for sending me his work on the *On the Flooding of the Nile*. I have learned much from Robert's and Katerina's work on the *Problemata* and kindred texts.

2 We have three ancient catalogs of Aristotle's writings, those given in the *Lives* of Aristotle by Diogenes Laertius (his *Life of Aristotle* is 5.1–35, the catalog is 5.22–27), by the so-called Anonymus Menagii (the text is also called the *Vita Hesychii*), and by someone called Ptolemy al-Gharīb, extant in Arabic translation. The catalogs in Diogenes Laertius and in the main body of the Anonymus both follow, with differences, a Hellenistic catalog (which has been attributed by different scholars to Hermippus or to Ariston of Ceos); the Anonymus also has an appendix taken from a different source or sources. Ptolemy is apparently following Andronicus' lost catalog. These catalogs are discussed in Moraux (1951), and are presented along with the *Lives* in which they are embedded by Düring (1957), except that for Ptolemy al-Gharīb Düring cites later sources (Ibn al-Qiftī and Ibn abī Usaibī'a) rather than the original text, which had not yet been published at that time. I cite the Anonymus Menagii = *Vita Hesychii* and also the *Vita Marciana* from Düring, and Diogenes Laertius from Dorandi (2013), but with Düring's catalog numbers. I cite Ptolemy al-Gharīb from Hein (1985, 414–39); she prints the Arabic text, and, on facing pages, translates the introductory material into German and the catalog into Greek.

But a Homeric problem, or more generally a poetic problem, means something different from a Democritean problem. Poetic problems and solutions (discussed in *Poetics* 25) are problems and solutions which can be raised about texts from the poets: Homer or some other poet seems to say something logically or linguistically or morally objectionable, and we see whether he can be saved from the objection, perhaps by reinterpreting or repunctuating or if necessary by emending or deleting. Aristotle seems to have written about problems of this kind, not only in Homer, but also more briefly in Hesiod, Archilochus, Euripides, Choerilus and other poets (Anon. #143–45), but there is no sign that he thought prose writers deserved this kind of treatment.³ A *Democritean Problem* is, rather, a *Problem from the [Writings] of Democritus*—not a problem about Democritus but a problem that Democritus himself had raised, which is the sort of thing that Democritus did, and Homer did not. The *Problems from the [Writings] of Democritus* would thus be like the *[Extracts] from Plato's Laws* in three books (D.L. #21, Anon. #23), or the *[Extracts] from the Republic* in two books (D.L. #22), or the *[Extracts] from the Timaeus and the [Writings] of Archytas* (D.L. #94, cf. Anon #85), or the works *Περί* or *Πρός* earlier philosophers (*Περί* the Pythagoreans, Archytas' philosophy, Speusippus and Xenocrates; *Πρός* Alcmaeon, the Pythagoreans, Xenophanes, Melissus, Zeno, Gorgias), amidst which the work on the *Timaeus* and Archytas is listed (D.L. #92–101, Anon. #83–89).⁴ The difference between the *Democritean Problems*

3 Plutarch's Πλατωνικά ζητήματα will be perhaps the first such treatise devoted to a prose author, and certainly the first extant one. But see Schironi (2005) for purely philological work on Plato by Alexandrian grammarians.

4 Presumably the *Πρός* works would either rely on, or else incorporate, the extracts or summaries of these philosophers' views and arguments in the *Περί* works. The works listed *πρός* Xenophanes, Melissus and Gorgias are presumably the extant *On Melissus*, *Xenophanes and Gorgias*. The manuscripts reported by Diels (1900) give its title with *Περί*, but in fact it includes distinct sections *περί* and *πρός*. Diogenes Laertius and the Anonymus Menagii give a *Περί* the Pythagoreans in one book (D.L. #101, Anon. #88), Diogenes Laertius also a *Πρός* the Pythagoreans in one book (#97), while Ptolemy may well have a *Περί* [the Philosophy of?] the Pythagoreans in two books (#23): here the transmitted text has "On the Art of Poetry according to the Opinion of Pythagoras and his Followers," but Hein, following Düring, thinks this is a conflation of two titles, *Poetics* and *On [the Philosophy of] the Pythagoreans*. If this is right, the two-book *Περί* might be the one-book *Περί* together with the one-book *Πρός*, and this would be an instance of Andronicus' preference for dividing the corpus into longer treatises than the Hellenistic Peripatetics. (I owe this point to Oliver Primavesi: see Primavesi, forthcoming.) Nothing depends for me on how many of these works are actually by Aristotle, rather than by other early Peripatetics. While the catalogs of Aristotle's works do not contain an *On Democritus*, Diogenes Laertius' catalog of Theophrastus' works does list an *On Democritus* (#184) and, separately, an *On Democritus' Astronomy* (#22), and his #23–27 are also clearly

and these other works is that the work on Democritus consists of problems and the others apparently do not, and this is because Democritus himself wrote in problems which a reader can excerpt from his work, whereas the other earlier philosophers did not write in problem-form.

Indeed, we might translate the title from Diogenes Laertius' catalog, not as *Problems from the [Writings] of Democritus*, but as *Problems from Those of Democritus*, i.e. *Problems from the [Problems] of Democritus*. And if we turn to Diogenes' catalog of Democritus' writings, we find a title (the last on the list, D.L. 9.49), mangled in the manuscripts to *χερνικά προβλήματα* or *χέρνιβα ἢ προβλήματα*, often emended to *χειροκμητὰ προβλήματα*—anyway the *προβλήματα* is secure.⁵ Admittedly this title comes on a list of extracts from Democritus' hypomnemata which "some" list alongside his other works, which do not seem to fit into tetralogies and may not have been in Thrasyllus' catalog, and which may be of more doubtful authenticity than the Thrasyllan works. But it hardly matters. Securely within Thrasyllus' canon are a book of Ἀπορήματα, and many books of Αἰτίαι—explanations of things celestial, aerial, terrestrial; having to do with fire; with sounds; with seeds and plants and fruits; with animals (in three books); with things timely and untimely (presumably in medicine); plus a book of miscellaneous Αἰτίαι, and, in the more dubious list at the end, explanations of laws or customs.⁶ The Aristotelian *Problemata* might equally well have been called Αἰτίαι—almost all of the individual problems start by asking a "why" [διὰ τί] question, and then go on to propose one or more explanations [ἢ ὅτι, ἢ διότι, ἢ διὰ with noun or infinitive]—and if Aristotle or someone from his school were excerpting from a work of Democritus' called Αἰτίαι, the resulting collection might equally well be called *Problems from the [Writings, or Problems] of Democritus*. These Democritean works, Αἰτίαι or Προβλήματα or Ἀπορήματα, are quite unlike the works attributed to other pre-Socratics (including Leucippus), who in most cases seem each to have written just a single cosmogonic narrative. Democritus too may have written such a narrative, perhaps the *Greater* or *Lesser Diakosmos*, but in works of Αἰτίαι or Προβλήματα he would be starting not from the beginning, from grand first principles which can explain the whole cosmos, but, like the Aristotelian *Problemata*, from the end, from particular phenomena that call out for

examinations Περὶ Democritus' views or writings on particular subjects. This *On Democritus*, strikingly, is next to an *On Causes* (#183); on Democritus and causes, see below. (Simplicius in *Cael.* 294.33–34 says that he will cite from Aristotle's *On Democritus*; this might be the work Diogenes Laertius attributes to Theophrastus, or another otherwise unattested work.)

5 See Dorandi (2013), and also Marcovich (1999, ad locum).

6 For the comparison between these titles for Democritus' works and the books of the Aristotelian *Problemata*, see Flashar (1962, 302–303), and the older scholarship he cites.

explanation. Perhaps eventually we will be able to tie this particular phenomenon back to the first principles, and so be able to insert it in an appropriate place in the grand narrative, but unless we start by surveying the phenomena to be explained and giving immediate explanations of each one, we will not know what to aim at in the grand narrative. And the particular explanations that are (for now) filed under Democritus' *Aerial Αἰτίαι* or *Αἰτίαι about Sounds* or *Αἰτίαι about Seeds and Plants and Fruits*—or under similar books of the Aristotelian *Problemata*—have not yet been inserted into the grand narrative.

Of course Aristotle does not accept Democritus' first principles—atoms and the void—or his ultimate explanations of other things through them. But he praises Democritus (specifically contrasting him with Plato) for his ability to survey [συνορᾶν] the things to be explained in physics, and to give appropriate physical explanations for each, rather than just spinning a story out of one's preferred first principles (for the contrast *GC* 1.2.315b24–316a14, συνορᾶν at 316a5). This is to say that Aristotle, like later authors, recognizes Democritus' devotion to αἰτιολογία; Dionysius of Alexandria (cited by Eusebius) reports that Democritus said that he would rather discover a single αἰτιολογία than have the kingship of the Persians (DK B118).⁷ And so it is natural that Aristotle or his school would compile a *Problems from the [Writings or Problems] of Democritus*. In collecting Προβλήματα they are doing something distinctively Democritean, without Platonic or other pre-Socratic precedent, and naturally they will build on whatever Democritus was able to contribute; even where they cannot accept Democritus' explanations, they will have to offer competing explanations of each of the detailed phenomena that Democritus has noted. Thus what is Democritean in Aristotle is not just the *Problems from the [Writings or Problems] of Democritus* but also, in a broader sense, the longer list of works in which this title comes embedded.

This list includes, to give Diogenes Laertius' version, at least the following:

#120 Φυσικῶν κατὰ στοιχείον λη

#121 Ἐπιτεθεαμένων⁸ προβλημάτων αβ

7 For discussion of this story and of the attribution of αἰτιολογία to Democritus, see Morel (1996, 24–27); Morel's book goes much further into Aristotle's attitude toward Democritus' αἰτιολογία.

8 Moraux' emendation (1951, 117) of ἐπιτεθεαμένων to ἐπιτεθειμένων is confirmed by Ptolemy's *muqaddamât li l-masâ'il*, “premises for the problems” or “things put before the problems,” in three books (three rather than two, but this kind of discrepancy is all-too-common); these might well be added problems, but the Arabic implies that they are put *before* the big *Problemata* rather than after. But since ἐπιτεθεαμένων is in the Anonymus Menagii as well as in Diogenes Laertius, the corruption (if that is what it is) must go back to their common source, and so Moraux' emendation should not be regarded as an emendation of Diogenes

#122 Ἐγκυκλίων αβ

#123 Μηχανικὸν α

#124 Προβλήματα ἐκ τῶν Δημοκρίτου β

#125 Περί τῆς λίθου α.

#120 is, given the unmistakable book-number λη = 38, certainly our *Problemata*, so we must understand the title as Φυσικῶν προβλημάτων κατὰ στοιχείον λη.⁹ And πρόβλημα (in some inflected form) should also be understood in some of the other titles. A work of ἐγκύκλια προβλήματα (#122 here—“popular, i.e. non-technical, problems”?) is cited by Aulus Gellius 20.4, and the title is known to Ptolemy al-Gharīb (who says it is in four books, his #77) and apparently to Aspasius (*in EN* 10.30–11.1); and what Gellius cites from it is what is transmitted as our *Pr.* 30.10 (why are travelling stage actors usually such bad people?), which shows that the same πρόβλημα-texts could be incorporated into different collections. The great bulk of the πρόβλημα-literature seems to go into our Φυσικά προβλήματα, but some people took some of the texts out and put them in other collections. Indeed, our transmitted Φυσικά προβλήματα contain many things which are not strictly physical, and which someone might well want to classify separately—most glaringly, *Pr.* 27–30, going through the canonical moral and intellectual virtues (and their contraries) in sequence, which might be the ἐγκύκλια προβλήματα (since it includes Gellius’ citation), if that was in

Laertius, but only of the title that he transmits. Even if the transmitted ἐπιτεθεαμένων can be defended, it would have to mean “considered in addition,” not “reflected on” or the like.

- 9 However, there is a difficulty in describing our *Problemata* as being ordered κατὰ στοιχείον. Moraux (1951, 115–16) argues from parallels that κατὰ στοιχείον means “ordered alphabetically,” so that the text must later have been reorganized κατ’ εἶδος, i.e. grouped by topic rather than alphabetically. (Our manuscript tradition gives the title as φυσικά προβλήματα κατ’ εἶδος συναγωγῆς. This is grammatically odd and perhaps should really be φυσικῶν προβλημάτων κατ’ εἶδος συναγωγῆς; perhaps it had been φυσικῶν προβλημάτων κατ’ εἶδος συναγωγῆς λη and a scribe, removing the numeral λη, turned φυσικά προβλήματα back into the nominative when he should instead have turned συναγωγῆ back into the nominative.) Flashar (1962, 311, n1) reasonably finds it implausible that the work would have had thirty-eight books both before and after a major reorganization (the number thirty-eight is both in Diogenes Laertius and in the Anonymus Menagii), and proposes to take “κατὰ στοιχείον” not as “in alphabetical order” but as “ordered one after another” or the like, but the parallels are not encouraging. If there was such a reorganization, it can only have been a reordering of *books* from an alphabetical to a more-or-less logical order, or conceivably a reordering of problems within each book (but in truth there is little logical order within each book as we have them), not a reordering of the individual problems throughout the treatise from one arrangement in thirty-eight books to another arrangement in thirty-eight books.

four books as Ptolemy says.¹⁰ Book 15 of our *Problemata* is mainly about optics, which for Aristotle is a mathematical rather than a physical science, and it might be the 'Οπτικόν, Diogenes Laertius' #114, which was not listed among the problem-works but is probably analogous to the Μηχανικόν, which was.¹¹

But it is not just that parts of our transmitted *Problemata* might alternatively have been transmitted separately. Also, conversely, things which are not part of our transmitted *Problemata*, and which we know only under other titles, were part of the same body of problem-literature, and might have been included in the *Physical Problems* with as much justification as some of the texts that are now included. (Indeed the seventy-book *Physical Problems* mentioned by some sources *must* have included many other such problems.) The *Vita Marciana* mentions "the *Medical Problems* and the *Physical Problems* which are in seventy books and the *Optical Problems* and the *Mechanical Problems*."¹² These *Optical* and *Mechanical Problems* seem to have the same status, and seem likely to be Diogenes Laertius' 'Οπτικόν and Μηχανικόν;¹³ and there is no reason not to identify the latter with our extant *Mechanics* (whether genuinely by Aristotle or not), which announces itself as about "mechanical problems" (847a23–24), arising from the combination of mathematical theorems with physical problems (847a24–28). Indeed, most of the *Mechanics* is in standard problem-form like our *Problemata*, asking a series of διὰ τί questions and proposing answers, except that it has been worked up with a proem, 847a10–848a37, and the next few chapters, after asking and answering their questions, are fitted with geometrical-style demonstrations (and doubtless diagrams) to make the answers more precise and convincing; after these chapters it relapses entirely into standard problem-form. The proem, sadly lacking in our *Problemata*, makes the *Mechanics* easier to use, and it is clearly part of the same project; when I talk about Democritus and the *Problemata*, I will mean *Problemata* in a sense broad enough to include at least *Mechanical* as well as *Physical Problems*.

To return to Diogenes Laertius' catalog: the *Problemata*-literature he cites also includes the *Problems from the [Writings or Problems] of Democritus*, and it also includes the immediately following Περί τῆς λίθου. Λίθος in the feminine is quite standardly a natural magnet (as in *De Anima* 1.2.405a20, *Physics*

10 See further discussion of *Pr.* 27–30 below.

11 *Pr.* 15 is for the most part about optics *as applied to astronomy*—but this too is a mathematical rather than a physical science.

12 Düring (1957, 97).

13 Elias (?) *In Categorías prooemium* 116.11–12, in a classification of Aristotle's works, speaks of "his mathematical [works], such as the Optical and Mechanical books that he wrote." Capitalization is of course an editor's choice, but τὰ Ὀπτικά καὶ Μηχανικά αὐτῷ βιβλία might well mean the monobiblia called Ὀπτικόν and Μηχανικόν.

8.10.267a2).¹⁴ Alexander *In Topica* 62.30–63.13 gives “how does the so-called magnetic stone [ἡ λίθος ἡ μαγνήτις λεγομένη] attract iron?” as a paradigm of a physical problem, “as he [Aristotle] has said in *On Problems*: for those natural things whose causes are unknown are physical problems.”¹⁵ Diogenes Laertius’ (Thrasyllan) catalog of Democritus’ works also includes a *Περὶ τῆς λίθου*, at the end of the list of works of αἰτίαι of this-or-that (9.47.5–13), and Moraux suggested¹⁶ that Aristotle’s *Περὶ τῆς λίθου* was part of his collection of annotated extracts from Democritus. That may be going too far, but at any rate the placement of the text in the catalog indicates that it was part of Aristotle’s larger post-Democritean project of physical problems, and it is very likely that he described Democritus’ opinion among others about how the magnet attracts iron. The *Περὶ τῆς λίθου* might be like the book *On the Flooding of the Nile*, listed by the Anonymus Menagii (#159) and Ptolemy (#26) and extant in Latin translation,¹⁷ which is clearly a *πρόβλημα* (beginning *propter quid?*)¹⁸ and discusses the views of earlier authors before giving its own explanation. The

14 See LSJ s.v. λίθος. Sometimes ἡ λίθος is some other special stone with marvelous properties, either a touchstone for testing gold or a transparent crystal which can be used as a burning-glass.

15 The reference would be to Aristotle’s *περὶ προβλημάτων* in one book listed among the logical works, Diogenes Laertius #51, Anonymus Menagii (without the *περὶ*) #48; Aristotle would be distinguishing between problems in the dialectical sense (whether about logical, physical, or ethical topics), which are yes/no questions not turning on causes, and problems in the physical sense, which ask τί ἐστὶ or διὰ τί. On problems in the latter sense see *Posterior Analytics* 2.14–15, and more broadly 2.14–18; and see Lennox (1994).

16 See Moraux (1951, 120–21).

17 The state of the art on the *On the Flooding of the Nile* is Beullens (2014), and, drawing on Beullens’ work, the text, translation, and notes on the treatise in Aubert (2014, 646 F1). There seem to be no good reasons why the work cannot be authentically by Aristotle, but as with other problem-texts all one can say with confidence is that it is from Aristotle’s school. Beullens argues tentatively for authenticity: the issue turns in part on the relation between this text and similar observations attributed to Callisthenes. If, as Ptolemy says, the treatise was originally in three books, the Latin might be translating a summary or an extract; but the Anonymus Menagii has no indication of a number of books, which suggests a monobibliion. (With this Latin text compare *Posterior Analytics* 2.15.98a29–34, which gives, as an example of a problem, why does the Nile flow more strongly in the second half of the month? Because it’s stormier, which is in turn because the moon is waning. The Latin discusses a monthly cycle and its explanation in the refutation of Athenagoras (Aubert 2014, 646 F1, paragraph 5) taken up again at the end (Aubert 2014, 646 F1, paragraph 10): here it is not clear whether the river is fullest at conjunction, or in the second half of the month, i.e. after opposition and before conjunction.)

18 The text explicitly speaks of a “problema” in the last paragraph, which is *πρόβλημα* in Greek in the corresponding passage of Photius (Aubert 2014, 646 T2a).

On the Flooding of the Nile does not actually mention Democritus' solution, but this may be because the author's own solution is very close to what we know of Democritus,¹⁹ and the whole treatise may be a reworking of Democritus.

2 Democritean Aetiology

We can understand Aristotle's legacy from Democritus a bit better by looking at some evidence about how Democritus himself understood what was distinctive about his activity of αἰτιολογία. It is not clear that Democritus has any word like "philosophy" or "wisdom" to describe his own work. Many pre-Socratics might have described what they did as περὶ φύσεως ἱστορία, but that is too narrow for Democritus, who also wrote about geometry and poetry and laws. (Thrasylus classified his works as ethical, physical, mathematical, musical, and technical, alongside other works that resisted classification.) Nonetheless, Democritus does seem to have had a self-conscious understanding of his own work and its relation to the more usual arts, namely that he is seeking the causes or explanations of the things done in the other arts. And he seems to have had a view about the place of this work in the development of civilization, or, as the Greeks would put it, in the sequence of the discoveries [εὐρήματα] of the arts, which collectively constitute what we might call civilization.

We have several fragments and testimonia of Democritus on how the discoveries of the arts were made, including one that comments explicitly on the order of discovery: Philodemus, in *De musica* 4, says that "Democritus, not only the greatest inquirer into nature [φυσιολογώτατος] of the ancients, but also second to none in curiosity about history [τῶν ἱστορουμένων . . . πολυπράγμων], says that music is more recent [apparently than the handicrafts], and he gives the reason [αἰτία] for this, saying that it did not arise from that necessity, but when there was already superfluity [ἐκ τοῦ περιεὺντος]."²⁰ Evidently the more strictly useful arts were discovered under pressure of necessity. In particular,

19 As noted by Aubert (2014, 646 F1) in the last paragraph of his commentary: see his references there for the sources for Democritus on the Nile. (Aubert does not suggest that this is the reason for the author's silence on Democritus.)

20 I follow the text of Delattre (2007, column 150, lines 29–39), which for Democritus' αἰτία reads μὴ ἀπ' ἐκείνου τὰναγκαῖον, ἀλλὰ ἐκ τοῦ περιεὺντος ἤδη γενέσθαι—whereas Diels-Kranz B144, following Kemke, had in the first clause μὴ ἀποκρίναι τὰναγκαῖον (and thus an apparent reference to Anaxagoras)—except that, following a correction proposed by Hammerstaedt (1998), I read τὰναγκαῖου instead of τὰναγκαῖον. For a detailed explanation and justification for reading ἀπ' ἐκείνου rather than ἀποκρίναι, see Delattre and Morel (1998).

they were not discovered by systematic reasoning from first principles, from understanding the order of nature. According to Plutarch *On the Cleverness of Animals* 20 “Democritus says we were students [μαθηταί] of [non-human animals] in the greatest things: of the spider in weaving and mending, or the swallow in house-building, and of sweet-voiced [animals], the swan and the nightingale, in song, by imitation” (974A6–10 = DK Democritus B154). Democritus’ inference about how people first learned to breed mules, by seeing a donkey impregnate a mare and turning it into a custom, uses very similar language (the humans were μαθηταί of what the animals did), here stressing the violence [βία] and the randomness [τύχη] of the original event, which was not by nature [φύσις].²¹ But whether what the animals did was natural or not, neither we nor the animals planned it rationally beforehand: we just happened to see it and saw that it produced good results. We could not have predicted the results beforehand, and in many cases we cannot explain them even after having seen them—certainly our ancestors had no explanation of the hybrid vigor of mules—but we learned how to imitate them and make regular practices out of them.²² This applies not only in necessary arts (house-building, learned from the swallow) but also in music (singing, learned from the nightingale and swan): our ancestors could not have predicted that this sequence of notes would be pleasing, and even after discovering it they could not explain it. Democritus stresses that the poets—like Homer, who “having received a nature sharing in the divine [θεάζουσα], constructed a cosmos of all kinds of speech” (B21)—did not understand what they were doing. Indeed, Democritus is our only source before Plato to say that the poets produce their successful works under the influence of a divine inspiration amounting to madness (texts collected at B17–18). The consequence is that it has been left to those who come after to explain the reasons or causes [αἰτίαι] for what the poets have done, and also for what is done in the necessary arts: in either case, the discovery of what works comes first, and the discovery of causes comes later.

21 Cited in Aelian’s *De natura animalium* 12.16 (DK A151). Aelian is an admirer of Democritus, citing his explanations of animal phenomena seven times, and seems to have had a good source, whether direct or not.

22 Cole (1967) tentatively reconstructed for Democritus, on the basis of parallels between later Greek discussions, an account of the cumulative εὐρήματα of the arts (and thus of the origins of civilization), each coming about by chance but preserved because of its usefulness. (So while philosophy cannot strictly explain why each εὐρημα came about, it can explain why it would be preserved if it ever happened—and given sufficient time, by the law of large numbers it will happen eventually.) Some of the steps of Cole’s Quellenforschung are, as he recognizes, less than certain, but the view he reconstructs for Democritus fits very well with what I am describing here.

Putting all this together, there seems to be a sequence of three stages of discoveries in the arts: first the εὐρήματα of the useful or necessary arts, then the εὐρήματα of the arts of superfluity such as music (taken broadly to include poetry), and then finally the discovery of causes, including the causes that explain the practices of both necessary and superfluous arts. No doubt in principle the causes of the necessary arts might be discovered before music, but since aetiology is itself an art of superfluity, and one supplying a more rarefied and less widely shared pleasure than music, it seems much more likely that music will arise at the second stage and aetiology at the third. Democritus himself, who would prefer a single aetiology to the kingship of the Persians, will come at the third stage, able to reflect on the εὐρήματα of the arts as well as on observations of nature. Notably in his “musical” treatises (*On Homer or on Orthoepey and Glosses, On Rhythms and Harmony, On Beauty of Speech, On Euphonous and Dysphonous Letters* and so on) he will explain, as Homer could not, the reasons *why* the expressions Homer chose are the best. And similarly with the “technical” works of Thrasyllus’ catalog: thus the Ἀτταί περὶ ἀκαριῶν καὶ ἐπιχαριῶν, on a list of medical works, will give the underlying reasons *why* the doctors apply treatments at some moments and not others, or why they are successful when they apply treatments at some moments and not others. And Vitruvius tells us, when Aeschylus’ stage-designer Agatharchus published a ὑπόμνημα on his designs (apparently for one particular tragedy), Anaxagoras and Democritus, starting from Agatharchus’ work, wrote treatises which explained, on the basis of a theory of lines of vision (perhaps resembling Euclid’s *Optics*), how to create illusions of three-dimensionality in two-dimensional scene-painting (Vitruvius *De architectura* 7, preface).²³ Democritus’ work would presumably have been the Ἀκτινογραφία of Thrasyllus’ catalog (there is also an *On Painting*), and would have given causes going beyond what Agatharchus himself could explain, but the optical theory would never have been discovered without the artisans’ work. Galen’s *On Medical Experience*, preserved in Arabic translation, says that “we find that of the bulk of mankind each individual by making use of his frequent observations gains knowledge not attained by another; for, as Democritus says, experience and vicissitudes

23 There has been much discussion of this passage: see, to begin with, Pollitt (1974, 236–47, esp. 240 ff.). Burnyeat argues for a more minimalist interpretation of what Agatharchus, and then Anaxagoras and Democritus, did (see Burnyeat 2005, 51, n39, referring to an unpublished paper, “‘All the World’s a Stage-Painting’: Scenery, Optics, and Greek Epistemology”); Burnyeat wants Archytas, a generation after Democritus, to be the inventor of mathematical optics. I find Burnyeat’s arguments, stated briefly in this footnote, unpersuasive, but I have not seen the apparently still unpublished article.

have taught men this, and it is from their wealth of experience that men have learned to perform the things they do" (9.5).²⁴ This tells us that people have made practical discoveries, not by following some rational plan, but by observation and trial-and-error; but it also tells us that each person will have some knowledge (at least practical knowledge) that even overall wiser people lack, so that it is worth inquiring into what they know, and then investigating the causes. (Indeed, it is not only people but also animals whose know-how can help us.) To ask for the causes of the things done in the arts is, in Aristotelian terms, to ask for the final cause $\delta\iota'$ θ the artisans do what they do; but since the reason why the artisans do it is that it works, to give the final cause of the practice is also to explain the efficient and material causes of the desired outcome. (In perhaps more Democritean terms, the fact that it works is not the cause of the initial discovery of the practice, but it is the cause of the practice's being continued and transmitted.) Democritus is reflecting not only on the arts, but also on the causes of natural things. But investigating the causes of the arts also leads to causes of natural things, and in some cases we would not discover these causes apart from the arts; and even when we investigate natural things not starting from the artisan's *practical* knowledge, we will still start from ordinary knowledge by experience.

Plato in the *Philebus* tells an anti-Democritean story, on which all discoveries in the arts (16c2–3) have come about through the dialectical methods of collecting and dividing: thus the discovery of writing came about not from an accumulation of experience and trial-and-error, but from a single past sage's comprehensive theoretical understanding (18b3–d2). But Aristotle sides with Democritus against Plato: discoveries are first made spontaneously, arts in a stricter sense arise when these discoveries are analyzed causally, and wisdom emerges only at the end.²⁵ Thus

24 Walzer's translation, from Walzer (1944, p. 99 for the English, p. 19 for the Arabic): *wa bi-l-jumlati nahnu najidu jam'a l-nâsi yablughu kullu wâhidin minhum min al-'ilmi bi-sti'mâli l-shay'i alladhî qad ra'ahu marâran akthara mâ lâ yablughu ghayruhu, li-anna l-amra 'alâ mâ qâla dîmûqrîtusû min anna l-tajârîba wa-l-nawâ'iba 'allamat al-nâsa dhâlika wa-anna bi-kathrati l-tajârîbi ta'allama al-nâsu hâdhihi l-ashyâ'a llatî yu'âlijûnahâ. In the last clause, dhâlika wa-anna needs to be emended at least to dhâlika wa-annahu, but perhaps rather to wa-dhâlika annahu: in which case the translation should be something like "... have taught men, since it is from their wealth of experience that men have learned to perform the things they do." (I think I owe this emendation to Lukas Muehlethaler.)*

25 As André Laks points out to me, Plato may be closer to Democritus in the account of the gradual rediscovery of the arts after a cataclysm at the beginning of *Laws* 3. But it is

everyone has in a way a share of both [rhetoric and dialectic]: for everyone tries up to a point to examine and to maintain an account and to defend himself and to accuse. Most people do these things either at random [εἰκῇ] or by habituation [διὰ συνήθειαν ἀπὸ ἔξωως]; but since both are possible, clearly it would also be possible to do these things methodically [ὁδῶ]. For it is possible to discern the cause [τὴν αἰτίαν θεωρεῖν] on account of which some people succeed by habituation and others spontaneously; and everyone would agree that this is the function of art (*Rhetoric* 1.1.1354a3–11).

Metaphysics A.1–2 also tell, in pursuit of an argument about the nature of wisdom, a Democritus-like story about the development of the arts: experience arises from sensation and memory, then art arises from experience when we go from knowing the ὅτι to knowing “the διότι and the cause” (A.1.981a28–30), where this includes prominently “the causes of the things done” (981b1), i.e. the *final* causes, the *reasons* for performing the prescribed actions, or the causes of their success. Aristotle takes up Democritus’ distinction between necessary arts and the non-necessary arts like music, from which the philosophical study of causes gradually separates itself, with a trichotomy between arts devoted to necessity, to pleasure, and finally to neither. Particularly Democritean is to stress the importance of leisure, “whence the mathematical arts first developed in Egypt, since there the tribe of priests was released for leisured pursuits” (981b23–25).²⁶ Wisdom proper emerges only at the end of the story,

not entirely clear where the musical inventions described at 677d come in the sequence of inventions, and the priority of discoveries to causal explanations seems not to be addressed.

- 26 The same tripartition is at A.2.982b22–24, if Jaeger’s supplement τῶν in b23 is correct. (Jaeger’s supplement is accepted by Oliver Primavesi in his edition of *Metaphysics* A in Steel (2012); see his survey of the evidence in his *apparatus criticus*.) The apparently Aristotelian text behind Iamblichus *De communi mathematica scientia* 26.115–31 (*Protrepticus* fr.8 in Ross (1955) = C55:2 in Düring (1961)) stays even closer to the Democritean origin-of-civilization story: “it is agreed that the precise concern with truth [ἀληθεία, i.e. the object of theoretical rather than practical philosophy] is the most recent of pursuits. For after the destruction and the flood they were first compelled to philosophize about sustenance and life [i.e. survival]; when they had more resources they worked out the arts directed toward pleasure, music and the like; then once they had an abundance of the necessary things they undertook to philosophize in this way. And now those who investigate geometry and λόγοι [= ?] and the rest of παιδεία have come so far from small beginnings in a very short time, as no other people [?: γένος] have come in any of the arts. And yet everyone joins in urging on the other [arts], honoring them in public

driven not by any practical need but solely by a desire to understand the causes of things.²⁷

Another apparently Democritean element in *Metaphysics* A.1–2 is that wisdom is seeking the causes not only of the practices and successes of the arts, but also, at a more basic level, of what is revealed to us in sensation; with the further specification that what is revealed in sensation is the *differences* of things (cf. A1.980a24–27). This theme is developed elsewhere both by Aristotle and by Theophrastus. Aristotle says in *De sensu* 1 that the external senses

belong to all [animals] that possess them for the sake of preservation, so that by sensing beforehand they may pursue food and flee bad and destructive things; but to those [animals] which also attain φρόνησις [the senses belong, not merely for the sake of continued existence, but also] for the sake of well-being [τοῦ εὖ ἔνεκα]: for [the senses] announce many differences, from which arises the φρόνησις both of things-to-be-thought and of things-to-be-done [νοητά, πρακτά] (436b19–437a3).²⁸

Obviously the senses' revealing the differences of things is not sufficient for wisdom, but, Aristotle is saying, it is necessary: neither practical nor theoretical wisdom would get started unless the senses presented reason with data to investigate and explain. And the senses would not do so unless they reacted differently to different external objects: the sensory responses do not reveal the nature of these objects (if they did, there would be nothing for reason to investigate), but there must be *something* in the natures of the objects to cause the different responses, and reason's task is to find out what. As Theophrastus puts it, "sensation both considers [θεωρεῖ] differences and investigates the causes; or perhaps it is truer to say that it hands them over [ὑποβάλλει] to reason, in some cases simply by investigating, in other cases by producing aporia, through which, even if it is not possible to make progress, nonetheless some light

and rewarding those who have them, whereas those who practice these [theoretical kinds of knowledge] we not only do not encourage, but often try to obstruct; but nonetheless they make great progress, since these are eldest by nature: for what is later in coming-to-be precedes in substance and perfection."

27 There is a similar juxtaposition and contrast between wisdom and the arts at *Div.Somn.* 1.463a4–7: good doctors say that one must pay attention to the patient's dreams for diagnosis of the present or prognosis of the future, "and it is reasonable for those who are not artisans, but investigating something and philosophizing, to make this supposition as well" (463a6–7).

28 Compare *Insomn.* 2 on the swift sensitivity of the senses to even small differences in things (this formulation 459b23–24 and 460a23–24), which helps to explain dreaming as described in *Insomn.* 3, including divinatory dreaming as described in *Div.Somn.* 2.

appears in the darkness as we investigate further: for there is no [scientific] knowing without some difference" (*Metaphysics* 8b10–17). This has antecedents in Plato (*Republic* 7.524d2–525a2),²⁹ but also in Democritus: Theophrastus in the *De sensibus* makes clear that Democritus identified the sensibles (i.e. hot and cold and so on) with πάθη of our senses, so that they do not have any nature in themselves which sensation would reveal, but that he also thought we should investigate the causes of each of these πάθη, tracing them back causally to atomic shapes (ἀνάγων εἰς τὰ σχήματα, 67.5).³⁰ Theophrastus finds it especially noteworthy that Democritus thought that not even hot and cold, which other philosophers had posited as ἀρχαί, have any nature of their own (63.4–5 with 71.7–8),

but that the shape, by shifting [μεταπίπτων], also produces the alteration in us. . . . A sign that these things are not by nature is that the same things do not appear to all animals, but rather what [is/appears] sweet to us [is/appears] bitter to others . . . and indeed that we ourselves change in temperament [χρᾶσις] according to our πάθη and our age; through which it is also clear that the disposition [of the percipient] is a cause of the appearance (63.5–64.2).

Theophrastus adds later that for Democritus

what [shape] there is most of [in the object] has the most impact [μάλιστα ἐνισχύειν] on the power and on the sensation, and also what condition [of the percipient] it comes upon makes not a little difference [διαφέρειν οὐκ ὀλίγον]; and on account of this the same thing sometimes produces contrary πάθη, and contrary things sometimes produce the same πάθος (67.8–11).³¹

29 Plato says that when the senses grasp some predicate (e.g. one, large, straight) not just by itself, but always together with its contrary, the soul is forced to ἀπορεῖν καὶ ζητεῖν (524e5)—these words or their cognates were in our Theophrastus passage, *Metaph.* 8b11–13—and is thus pushed toward intelligible reality, as it would not be if sensation had not provoked it to aporia.

30 Although ἀνάγειν here would be *reducere* in Latin, Democritus is proposing not ontological “reduction” but a causal investigation: ἀνάγειν εἰς should be understood in the sense of ἀνάγειν εἰς τὰς ἀρχάς, the standard phrase for explaining anything by tracing it back step-by-step to the principles which are its ultimate causes (e.g. Aristotle *Phys.* 2.3.194b17–23, 8.1.252a32–b2, *Metaph.* A.9.992a10–11).

31 I am following Diels' text in Diels (1879), thus accepting both Schneider's διὰ τοῦτο for what is apparently the MS τοῦτο διὰ, and his bracketing of γάρ. Stratton (1917) tries to keep the MS text, but I am not sure that it is grammatically possible.

It is presumably the discovery that the same thing can be perceived first as sweet and then as bitter (because of a difference in the percipient, a slight admixture or rearrangement, or a change of external circumstances) that leads us to realize that “sweet” and “bitter” or even “hot” and “cold” are not satisfactory stopping-points in explaining our perceptions. Without these stimuli to inquiry we would never come to discover atoms and the void in general, or the particular atomic shapes and arrangements that are responsible for particular appearances—thus a slight external cause produces a complete change of an object’s appearance, and we posit that this is due to one of the three διαφοραί, shape and turning and order, as the whole meaning of a word changes through an addition or transposition of letters.³²

Simplicius cites Theophrastus’ *Physics* as reporting that Democritus “ascended [ἀνέβη]”³³ to atoms, on the ground that those who give causal explanations [αἰτιολογεῖν] in terms of the hot and the cold and so on are explaining amateurishly [ἰδιωτικῶς ἀποδιδόντων]” (Simplicius in *Cael.* 564.24–26, repeated

32 Our catalogue of Democritus’ works includes a title Περὶ τῶν διαφερόντων ῥυσμῶν, in the middle of a list of titles on sensible qualities, sensations, reshaping, and judgments on conflicting sensory reports (Diogenes Laertius 9.47). Aristotle treats Democritus as the most obvious authority on διαφοραί, and says that he posits three kinds of διαφοραί, ῥυσμός and διαθιγή and τροπή, i.e. the shape and ordering and orientation of the constituent atoms of a compound (*Metaph.* A.4.985b10–19—where these διαφοραί are described as causes—and H.2.1042b11–15). Democritus compares the atoms to letters of the alphabet, A differing from N by shape, AN from NA by ordering, and Z from N (or an archaic version of Z from H) by orientation (*Metaph.* A.4.985b17–19), and to illustrate how a slight change in these διαφοραί can yield an entirely different appearance in the compound, he said either that a tragedy and a comedy come to be from the same letters, or that τραγωδία and τραγωδία (an archaic word for comedy) come to be from the same letters except one (Aristotle *GC* 1.2.315b6–15; for the emendation from κωμωδία to τραγωδία see West (1969)). On the need of sensation in order for reason to make a start in determining the natures of things see Democritus B125. On the need more specifically of the kind of sensory stimulus we have been discussing (where e.g. the same thing appears successively sweet and bitter) we might compare not only Plato *Rep.* 7.524d2–525a2, as above, but also Sextus Empiricus *PH* 1.12, where great-natured people turn to inquiry because they are in ταραχή “on account of the ἀνωμαλία in the matters at hand [ἐν τοῖς πράγμασιν], and being in aporiai about which of them they should rather assent to, they came to inquire what is true and what is false in the matters at hand, in order that by being able to distinguish these [ἐκ τῆς ἐπικρίσεως τούτων] they should be free of ταραχή.” The ἀνωμαλία, and the consequent ταραχή, seem close to what Aristotle calls θαῦμα, and to its Democritean antecedent.

33 Or, perhaps, “went back,” if ἀναβαίνειν is the same as ἀνάγειν εἰς τὰς ἀρχάς.

576,13–16);³⁴ further on Simplicius says more fully, perhaps expanding on his own authority, “explanations in terms of the hot and the cold and so on were said by Democritus before [sc. before the *Timaeus*] to have been given amateurishly, as Theophrastus reports, the soul desiring to hear another ἀρχή more appropriate/akin to the nature of body [sc. as three-dimensional extension] than such an activity of the hot” (641.5–9). Presumably it is perfectly all right in some contexts to trace some effects back to the activity of the hot, e.g. in explaining what happens to dough when it is put in the oven, or why bakers put this kind of dough in an oven so-prepared for so-long. Democritus in saying that these explanations are given amateurishly does not mean that the person who gives them cannot be an expert in baking. But, for the kinds of reasons we have seen, these explanations are not satisfying as final resting-places. When people first try to reflect systematically on the causes of natural and artificial things, they are likely to give explanations in terms of the hot and the cold, but as the discipline progresses we will need to press on to the first and more comprehensive causes, closer to the nature of things, and anomalies such as the same thing producing contrary πάθη, appearing hot in one circumstance and cold in another, are signs that we have not gotten there yet. Aristotle can only agree with Democritus, both on the need for reason to seek causes of the differences revealed by sensation, and on the need to keep pressing on to the first causes and principles, even if he entirely disagrees about what these first causes and principles are.

3 The *Problemata* and the Democritean Program of Explanation

To come back closer to the *Problemata*: the realization that there is something further that needs to be explained, whether in the appearances of natural things to our senses or in what is done by art, is what Aristotle calls θαύμα, “wonder.”³⁵ There is nothing to link this word with Democritus, but Democritus

34 Simplicius’ point in context is that the *Timaeus* does something similar in explaining heating and cooling, and the sensations of hot and cold, through the triangles. Simplicius is arguing here against other Platonists who respond to the question why fire heats and water cools by saying that fire is hot and water cold, and that once we have posited these as ἀρχαί we have no need to seek any further cause of these ἀρχαί.

35 Aristotle seems to be drawing on the use of “θαύμα” in Plato’s *Theaetetus*, notably 155d2–5 on θαύμα as the origin of philosophy. This passage is in the context of “Protagoras” using the dice example (154c1–5) to create θαύμα, and thus to motivate his “secret doctrine” as explaining and resolving the aporia.

has the concept of an experience that spurs investigation, and he and Aristotle share some views about how this happens. Aristotle (or his school) discuss θαῦμα particularly in two texts, our apparently Democritizing proem to the *Metaphysics* and the proem to the *Mechanics*. In the *Metaphysics* Aristotle's stress is that θαῦμα gives a non-utilitarian motivation for wisdom: "the person who ἀπορεῖ and θαυμάζει thinks that he is ignorant," so that "they philosophized in order to escape ignorance" (A.2.982b17–20), rather than to use their knowledge for something further. Both the *Metaphysics* and the *Mechanics* say that θαῦμα can arise both at natural things (the *Metaphysics* gives as examples the solstices or "turnings" [τροπαί] of the sun, and the παθήματα of the moon, presumably phases and eclipses) and at artificial things (the *Metaphysics* gives the example of automata, mechanical devices set up to act in an apparently purposive way when triggered by a small stimulus, and often described as θαύματα); the *Metaphysics* also gives a purely mathematical example, θαῦμα at the incommensurability of the side and the diagonal. The *Mechanics* says that θαῦμα arises at natural things when we are ignorant of their causes, and also at the contrivances brought about by art when, because changing human purposes are often contrary to what nature is disposed to produce, people contrive to bring about something contrary to nature. Such a situation "provides aporia and requires art," and the part of art that comes to our aid and allows to overcome [κρατεῖν] such aporia is called μηχανή, literally "contrivance" (847a16–19). In such cases we are as-it-were tricking nature, getting it to do the contrary of what it is disposed to do, as when "lesser things overcome greater things, and things that have a small power [ρόπή] move great weights, and pretty much all of what we call mechanical problems" (847a21–24). For clarity we can distinguish two related types of problems. First, there are the problems the artisan faces in trying to overcome a contrariety between nature and human purposes, which can be stated in the grammatical form of a mathematical problem with an infinitive phrase, "to move a given weight by means of a given force." Second, there are problems that Aristotle (or whoever our author is) describes as involving θαῦμα like our θαῦμα at natural things, when the artisan has succeeded in solving his problem, but we spectators do not understand *how* his contrivance works, and so we also do not understand the final cause, *why* he is doing what he does. (In the case of the temple-wonders described at *Mechanics* 848a19–37, the artisans don't *want* us to understand, but to continue to θαυμάζειν.) Solving either type of problem depends on understanding the different natural powers involved, and why they will under certain circumstances produce the contrary of the expected effect.

The connection between θαῦμα and contrariety has been stressed since the first lines of the *Mechanics*, on the contrariety between nature and human

purposes, and remains a constant theme: “most θαυμάσιον is for contraries to arise bound up together [μετ’ ἀλλήλων]” (847b18–19). Democritus too, without the word “θαῦμα,” had already said (according to what we have seen from Theophrastus *De sensibus*) that when the same thing causes contrary effects in different circumstances, or contrary things cause the same effect, that makes us aware that we have not yet understood, and impels us to search for a further cause. Aristotle’s examples of θαῦμα in the *Metaphysics* proem also seem to turn on contrariety. Thus the solstices are literally the “turnings” of the sun: why, having moved north steadily from midwinter to midsummer, does it now turn around and go south until midwinter, and then turn around and go north again—how can something produce both a northward and a southward motion? The moon waxes and then wanes, and its special θαῦμα can be put by asking “why is the moon sometimes darkened just at the time of month when it is fullest and brightest?” Aristotle puts the incommensurability example by saying “it seems θαυμαστόν . . . if they are not measured even by the smallest [length]” (A.2.983a16–17); we could explain this by saying that the common measure of two lengths can be discovered by repeatedly subtracting the smaller from the larger until there is no remainder, and that where the lengths are incommensurable this process continues *ad infinitum*, producing smaller and smaller remainders, so that our finite initial lengths turn out to contain infinitely many components, and to be unlimitedly large in relation to them. (Also, in a common way of proving the incommensurability of the diagonal with the side, “odds turn out to be equal to evens if it is posited commensurable,” *Prior Analytics* 1.23.41a25–27.)³⁶ Democritus already had been interested in such mathematical θαύματα: he was the first and indeed apparently the *only* Greek philosopher to write a book on incommensurables, and his book “On the Contact of the Circle and the Sphere” probably discussed the “horn angle” between a circle and a tangent line, which remains smaller than any rectilinear angle bisected any number of times.

It is worth noting a connection between the *Metaphysics* and *Mechanics* proems on the way they explain at least some of the θαύματα they consider. The *Mechanics* proem is building up to a rather bizarre celebration of the θαυμάσιον character of the circle, whose paradoxical properties (a rotating circle is compounded out of contraries, motion and rest, and contrary motions on opposite sides) allow it to be responsible for all kinds of mechanical θαύματα.³⁷

36 On “mutual subtraction” and “even-odd” proofs of the incommensurability of the diameter with the side, see, for instance, Knorr (1975, ch. 2).

37 This seems to be building on Plato *Laws* 10.893c4–d5, where circular motion is the source of all kinds of θαυμαστά, by producing slow motion near the center and fast motion at the

But circular motion also explains the paradoxical τροπαί of the sun from the *Metaphysics* proem. Rather than one motion that brings the sun north from winter solstice to summer solstice, and then a contrary motion proceeding from a contrary cause that brings it back south from summer solstice to winter solstice, there is a single uniform motion that carries it around the circle of the zodiac. Observers who are noting only how far north or south it is (and thus its rising and setting points on the horizon, the length of the noon shadow, or the length of daylight) will see it as moving with contrary motions, and will θαυμάζειν; those who consider the sun's motion not as alternating north and south but as motion in a circle will understand the cause of the phenomena.

The Aristotelian *Problemata* literature in general take up the program sketched in the opening lines of the *Mechanics*. Every problem of our *Physical Problemata* takes up something capable of causing θαῦμα, brings out the θαῦμα that it involves, and then tries to resolve this θαῦμα by offering an explanation. Θαῦμα can arise, as the *Mechanics* says, either from natural things or from artificial contrivances, and while the *Physical Problemata* are, as their title indicates, mainly concerned with natural things, they also take up examples from the arts, especially medicine and music, and there are often connections between the natural and artificial cases. The process of raising and resolving θαῦμα helps call our attention to the differences we are capable of perceiving in things, and helps lead us to knowledge of their causes. The more the θαῦμα is intensified, the more we will be motivated to seek causes, and the less likely we are to rest content with too vague and general an explanation. Θαῦμα is intensified when something does the direct contrary of what we expect, as in the Democritean cases where something that tastes sweet under some circumstances, and which we might expect (from our limited experience) always to taste sweet, turns out to taste bitter in other circumstances. The best way to understand the natures of X and Y is to understand their differences, and we do this best starting from circumstances in which they have not merely different but contrary effects; and the θαῦμα is strongest, so that we recognize most clearly that we have not yet understood the cause, if the obvious explanations

circumference. (Thanks to Robert Mayhew for pointing this passage out to me.) Jonathan Beere (in conversation) suggests that there is a tension between the *Metaphysics* and *Mechanics* proems in that, for the *Mechanics*, the circle and the things resulting from it remain θαυμάσια even after we've given an explanation. In my view this is taking too straightforwardly a rhetorical exaggeration, suitable to a proem, about the circle (or its property) as θαυμασιώτατον. The author does say, a few lines further down, that if we consider more we will be able to θαυμάζειν less at the contrarieties arising from the circle (847b21–23).

of the effects are defeated, because the same cause would have contrary effects or contrary causes would have the same effect.

The *Problemata*'s obsession with contraries is illustrated notably in *Pr.* 21, on barley.³⁸ This is part of *Pr.* 20–22, on plants and their products; keeping to the anthropocentric and medical focus of much of the *Problemata*, the concentration is on plant products as parts of human diet, and so the questions concern not just natural things but also things done by art—not just agriculture but also milling and baking. But, much more than we would expect from this context, the book is focused on the differences, and especially the contrarieties, between barley and wheat, the Greeks' two main cereal crops. Thus 21.3 and 7 ask “why is the first[-ground] of wheat flour, but the last[-ground] of barley meal, brighter?”, 21.8–9 and 15 ask “why does barley-cake become harder to digest [resp. smaller, darker], but wheat-bread easier to digest [resp. larger, lighter], the more they are kneaded?”, 21.26 “why does wheat-flour become less compact when it cools, but barley-meal more so?”. These questions are more complex than asking why wheat is better digestible than barley, or why grinding and moistening and heating them make them more digestible: they cannot be answered simply by saying that wheat is more F than barley, or that moistening and heating make things more F. So too, for instance, 4.25 and 28 on why men are more capable of sex in winter than in summer, but women more in summer than in winter; 9.2 and 7 on why scars on the body make it darker but scars on the eye make it lighter, and 9.3–4 on why blows from fennel-stalks yield scars with a white center and red periphery while blows from wood yield a center redder than the periphery; 10.22–23 on why sheep-hair is softer when newly grown in after a shearing and gets harder as it gets longer, while human hair is harder when newly grown in and gets softer as it gets longer; 26.39 and 45 on why the south wind begins weak and ends strong while the north wind begins strong and ends weak; the *On the Flooding of the Nile* on why other rivers are greater in winter and lesser in summer but the Nile is greater in summer and lesser in winter. So too, perhaps especially, in the medical *Problemata* 1: 1.1–2 on why great excesses (e.g. of consuming something) are disease-producing but are also often used to cure diseases;³⁹ 1.53–54,

38 In citing from the *Problemata* over the next few pages, I often follow Robert Mayhew's translation (Mayhew 2011a and 2011b).

39 While the standard chapter-division of the *Problemata* in modern editions (which I accept for convenience) is intended as a division into problems, and while this division is usually reasonable, it seems to me that *Pr.* 1.1–2 should be understood as a single problem rather than as two. 1.1 by itself would ask why great excesses are disease producing, but the real problem is why, *although* great excesses are disease-producing, doctors often cure

“why are both cold and hot water beneficial to chilblains?” and “why does cold both produce and stop chilblains, and heat both produce and stop burns?”; 1.43 on why a small amount of pepper loosens the stomach but a large amount the bladder, while a small amount of scammony loosens the bladder but a large amount the stomach; and 1.44, “why do some treat by cooling, while others concoct by heating, the same inflammations?”. While the *Problemata* almost never use the word θαῦμα⁴⁰—but neither, apparently, did Democritus—all of these are θαυμαστά, and they are mentioned in this sharpened form in order to raise and then to resolve θαῦμα.

Θαῦμα might lead to science, as in the physical and mathematical examples in the proem of the *Metaphysics*: “why is that X? Is it because Y?” can lead to a systematic scientific exposition of things in the genus of X, in which Y is given as the cause of X. But there is no reason to suppose that this happened, or even was intended to happen, with *every* Aristotelian problem. “Why is that X? Is it because Y?” might also be used in a much less systematic way as an illustration in the course of an argument about something else: “X: αἴτιον δὲ Y” or “Y: σημείον δὲ X.” And, as the examples from *Problemata* 1 help make clear, θαῦμα might lead not to theoretical science but to art. Many of the problems from *Pr.* 1 that could be described as being about the powers of natural things—e.g. 1.43 above on pepper and scammony—could equally be described as about the practices of doctors, who prescribe pepper or scammony or hot or cold water in particular circumstances.⁴¹ To ask why they do it is to ask why it works, or, at least, why it works more often than could be explained by mere chance. For Aristotle as for Democritus, arts typically begin from chance εὐρήματα, but we must then ask why the artisans do this, i.e. why this εὐρήμα works; Democritus is willing to call it an art even before we know why, whereas for Aristotle (following Platonic and perhaps medical distinctions between τέχνη and ἐμπειρία) the art is only properly completed when the cause has been grasped. Investigating why the εὐρήμα works might also lead in some cases to theoretical knowledge of nature, e.g. perhaps to theoretically interesting knowledge of the properties of pepper and scammony or of plants in general—indeed, the author of *On Ancient Medicine* thinks that such causal investigation of the effects of foodstuffs and drugs is

diseases by subjecting the patient to some great excess. The connective δὲ at the beginning of 1.2 supports taking 1.1–2 as a single problem.

40 -θαῦμα- occurs in the *Problemata* only five times, at 16.1.913a22, 18.6.917a8, 19.42.921b28, 28.4.949b23, and 30.1.955a12. The second and fourth of these are in not really relevant senses, and none of these passages is especially helpful.

41 This is true especially in the second half of *Pr.* 1, 1.30–57, which is marked in the manuscripts with a new heading ὅσα [προβλήματα] βοήθηματικά πρὸς ἰασιν or the like.

our only path to knowledge of nature. Medical examples in the *Problemata* of course extend far beyond Book 1, and there are also other examples that extend beyond the range of natural things to consider some human practice, properly artistic or not. *Pr.* 19 is entirely about music, purely vocal or with the lyre or aulos, much of it about the different notes on a scale. While some of the questions are purely physical (e.g. about sympathetic vibration), many of them are asking either why listeners take pleasure in certain things, or why musicians do (or formerly did) certain things (why did older lyres leave out the note $\nu\eta\tau\eta$, why is only the octave used for simultaneous non-unison singing, why do tragic choruses not use the Hypodorian or Hypophrygian modes; also questions about the *names* of some musical practices, solved by positing early stages in the history of music). And even the physical questions slide easily into asking why sounds produced in a certain manner appear in a certain way to listeners, or are more or less perceptible, or are consonant—which rejoins the questions about what listeners take pleasure in. Presumably understanding either the (final) causes why musicians do certain things or the (efficient) causes of pleasure in the listeners would be contributions to the art of music. (*Pr.* 19.41 proposes to explain why the double-fifth and double-fourth are not consonant although the double-octave is, that only multiple ratios $n:1$ and epimoric ratios $n+1:n$ are consonant, and the octave is a multiple ratio $2:1$, whose double is the multiple ratio $4:1$, while the fifth and fourth are epimoric ratios $3:2$ and $4:3$, whose doubles are not epimoric. Euclid arranges these propositions in a different order in his *Sectio canonis*, postulating in the proem that only multiple ratios $n:1$ and epimoric ratios $n+1:n$ are consonant, and inferring in Propositions 10–11 that the octave is a multiple ratio, since its double is also consonant, and that the fifth and the fourth are epimoric ratios, since their doubles are not consonant; he then infers that the octave is the ratio $2:1$, the fifth $3:2$, and the fourth $4:3$, since this is the only way that a multiple ratio can be composed of two epimoric ratios.) *Pr.* 19, perhaps even more than the medical books, goes beyond what the title *Physical Problemata* would suggest; but it is exactly the kind of mixing of physical and artistic causal investigation that was Aristotle's legacy from Democritus.

The “causes” of things done in the arts are, often, their justifications—at 20.15, why do people water their crops either early or late in the day, the (first) answer is explicitly an “in order that” clause. And other problems that go beyond the realm of the strictly physical, and also beyond the realm of the strictly artistic, are also asking for justifications. Our *Problemata* include four books on virtues and their contrary vices and connected passions, 27 on courage, 28 on temperance, 29 on justice, and 30 on intellectual virtue, including the famous problem on melancholy. Some of these problems can be described as

“physical,” concerned with the physiological accompaniments of these states (27.1, “why do those feeling fear tremble? Is it because of the cooling. . .”),⁴² but some are concerned with the “causes” of human practices of evaluating these states and actions (27.5 “why do cities honor courage most of all, though it is not the best of the virtues?”). This is especially so in *Pr.* 29, on justice: the problems are, as elsewhere, often comparative, and they go easily back and forth between “why does it *seem*/why is it *thought* more just/unjust to do X than Y” and “why is it more shameful/more terrible [δεινόν]/more unjust to do X than Y.” And questions about the causes of people’s practices of saying or thinking or feeling certain things to be just or unjust slide into questions about the causes of judicial institutions: why is the punishment for this greater than the punishment for that, “why, when the votes for the defendant and the prosecutor turn out equal, does the defendant win?” (29.13). Obviously not all of these practices are *right*, and neither is everything people do in trying to heal wounds and diseases, but people sometimes do the right thing, from some natural endowment or from habituation or by sheer chance, and if it is possible to sort through retrospectively what works and what doesn’t, and then to discover the causes of success, this is the path on which a perfected art can be established—in the case of *Pr.* 29 perhaps an art of legislation.⁴³ Not everything the poets do is right either, not even Homer, and when they do something right, perhaps by inspiration, they cannot explain why. A Homeric problem asks why Homer said some particular thing, and these often take the form of challenges, when he has said something apparently incorrectly, because otherwise there is nothing to wonder at (“why should so good a poet have said that?”); the solution explains the justification, and collectively these solutions may allow the formulation of an art, at least of judging poetry and perhaps of composing it, where our predecessors could act only by nature or habit or inspiration. So, to pick up a question from the first paragraph of this essay: since Aristotle wrote not only *Democritean Problems* but also *Homeric Problems*, and since *Homeric Problems* certainly have nothing do with our *Problemata*, why should

42 Compare *EN* 7.3.1147b6–9, where in explaining how the πάθη involved in ἀκρασία arise and cease, at some point we pass beyond the domain of ethics and need to ask the φυσιολόγοι.

43 For establishing an art by discovering the causes why some already discovered practices succeed, see *Rhet.* 1.1.1354a1–11, cited above. Problems about why people admire or blame X, or admire or blame X more than Y, are (as Robert Mayhew points out to me) similar to the many problems about why there is a certain proverb, or why “it is said” that p. (Aristotle’s student Clearchus wrote a work on proverbs—the fragments are collected in Wehrli (1969, frs. 63–83). Theophrastus too wrote an *On Proverbs* (D.L. 5.45), about which we have less information, see frs. 737–38 FHS&G). Mayhew (2012) discusses problems about proverbs and “things said” in the *Problemata*.

Democritean Problems be any more relevant? Democritus, not Plato and not straight pre-Socratic physicists, gave Aristotle a model for doing at least some of his philosophy through problems διὰ τί: for Democritus, as for Aristotle, these problems can be about natural things or about the arts, often medicine but also music and poetry and legislation. For Aristotle, as for Democritus, retrospective philosophical reflection on the causes of these things gives the path to the final stage of the development of knowledge, although the results of the *Problemata* literature will need to be systematically reorganized for their grasping of particular causes to turn into science, and although undoubtedly many individual problems will lead to nothing scientific at all. The Peripatetic *Problemata* literature, whether collected in our *Physical Problemata* or in the *Mechanics* or the *Homeric Problems*, is part of the legacy of Democritus, not only his volumes of *Problemata* or *Aitai* or *Aporemata* but also his “musical” works, the *On Rhythms and Harmony* [Scales?] and the *On Euphonous and Dysphonous Letters* and the *On Homer or on Orthoepey and Glosses*, investigating whether Homer is speaking rightly and, if so, why. And so, in a broad sense, even Aristotle’s *Homeric Problems* are Democritean problems.⁴⁴

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44 With such “cultural” Democritean problems we might also compare Plutarch’s Αἴτια Ῥωμαϊκά and Ἑλληνικά, and Πλατωνικά and Συμποτικά ζητήματα: the Greek and Roman αἴτια might generically resemble Democritus’ Νομικά αἴτια. (Plutarch also has Αἰτιαί φυσικαί, inspired by our Aristotelian Προβλήματα φυσικά.) Plutarch’s Roman problems typically ask διὰ τί about the rationale for some custom, perhaps the circumstance that led to its first institution, or a purpose that it serves, or the meaning of some word or what some action imitates. (The Greek problems often phrase the question as τίς ὁ Χ or the like, asking e.g. for the meaning and origin of a name transmitted in a ritual, or a *Geflügeltes Wort*.) Such “cultural” problems may be seen as competing, in part, with the poets’ mythical aetiologies of rituals. On Plutarch’s problem-collections, and their links with Peripatetic Problemata, see Oikonomopoulou (2013) and, for the Συμποτικά ζητήματα, the articles by Oikonomopoulou and Elena Kechagia in Klotz and Oikonomopoulou (2011).

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Aristotle's *Posterior Analytics* and the Aristotelian *Problemata*

James G. Lennox

1 Introduction

The Aristotelian concept of a problem arises naturally from the Socratic world of question and inquiry. The “logic” of Socratic elenchus is erotetic, not assertoric: the questions asked determine an inquiry’s trajectory and the kinds of answers that are appropriate. It focuses attention on the *process* of coming to know. In the second chapter of the *Posterior Analytics*, Aristotle bases his concept of unqualified demonstration on having knowledge of the cause of the predicative relationship identified in the conclusion of a demonstration. That causal knowledge rests, as the *Physics* stresses, on having proper answers to the question ‘on account of what?’ (διὰ τί;), the types of answers being as many as the types of causes (*Phys.* 2.3.194b18–20; 2.7.198a14–17).¹

It is thus not surprising that when Aristotle opens the second book of the *Posterior Analytics* (*APo.*) by distinguishing four things we seek (τὰ ζητούμενα), corresponding to four sorts of things we know, these are identified as two pairs of *questions*: an affirmative answer to the question “Is there an X?” leads naturally to the question “What is X?”; an affirmative answer to the question “Is it the case that X is Y?” leads naturally to the question “Why is it the case that X is Y?” (*APo.* 2.1.89b23–35). One pair of inquiries eventuates in knowledge of a thing’s essence, formulated in a *definition*; the other pair eventuates in knowledge of *the reason why* some state of affairs is as it is, formulated as a demonstration, in which the middle term refers to *the cause* of that state of affairs. The first ten chapters of that book are engaged in a quest to understand how these two pairs of inquiries are related. By the conclusion of chapter 10, they have been shown to be tightly interwoven inquiries—indeed, one type of demonstration prevalent in science as Aristotle depicts it can be reformulated as a definition of the phenomenon being explained.²

1 On the Socratic background to Aristotle’s epistemology, see Ferejohn (2013).

2 As he puts it, such a definition “will clearly be like a demonstration of what something is, differing in arrangement from a demonstration. For there is a difference between saying why

And yet, if Aristotle is to avoid the paradox of the *Meno*, an issue about which he repeatedly shows himself to be concerned,³ inquiry does need to be a process with distinguishable stages—for it must begin with our perception of distinct particulars and it must end with first principles which are universal, indemonstrable truths, and which identify fundamental causes constituting the essences of things.

Immediately after quoting the opening lines of *APo.* 2.1, the author of a commentary on *APo.* 2 attributed to Philoponus glosses it in a most insightful way: “He [Aristotle] says that there are as many *problems* that are investigated as there are ways by which we have scientific understanding and know. There are four things that are investigated; therefore there are four ways by which we know” (366.4–6, trans. Goldin).⁴ The actual Greek for the subject of this sentence in Aristotle’s text is τὰ ζητούμενα (“the things sought” or “the objects of inquiry”) but our commentator feels comfortable substituting τὰ προβλήματα for it. Similarly, in the commentary on the *Topics* authored by Alexander of Aphrodisias, while drawing a distinction between natural problems and dialectical problems, he makes the same tight connection between Aristotle’s opening taxonomy of inquiry in *APo.* 2.1 and the method of problems:

So since things stated this way—“why is this the case?” or “what is this?”—are not <dialectical> premises to begin with, neither would problems <stated this way> be dialectical; still, it is possible that the things proposed in this manner are natural problems, as has been said in the work *On Problems*; for natural things, the cause of which are unknown, are natural problems.... And all the dialectical problems might be reducible to “that it is” and “whether it is” inquiries, which are two of

it thunders and what thunder is. In the one case you will say: Because the fire is extinguished in the clouds. But: What is thunder?—A noise of fire being extinguished in the clouds. Hence the same account is given in different ways: in one way it is a continuous demonstration, in the other a definition.” (*APo.* 2.10.94a1–7; Barnes trans.) For a detailed exploration of the metaphysical underpinnings of the relationship between definition and causal explanation in *APo.* 2, see Charles (2010b).

- 3 The “aporia of the *Meno*” is explicitly referred to at *APo.* 1.1.71a29 (as is that dialogue’s doctrine that learning is recollection at *APr.* 2.21.67a21). But it is also clearly in the background of the *aporia* that introduces *APo.* 2.19. On Aristotle’s responses to the *Meno* paradox, see Charles 2010a.
- 4 For a good discussion of the reasons for doubting that the commentary on *APo.* 2 is by Philoponus, see Goldin (2009, 1–4). Unless otherwise noted, the translations in this paper are my own, though for the *Posterior Analytics* I have regularly consulted the translations of Barnes, McKirahan, and Tredennick.

the four discussed at the beginning of the second book of the *Posterior Analytics*; for the “why it is” and “what it is” are not dialectical problems. (in *Top.* 63.9–19)⁵

These references take the link between proposing or identifying problems and Aristotle’s theory of inquiry for granted; and the quote from Alexander takes two further steps: it supposes that natural problems will be formulated either as “what is it?” or “why is it?” inquiries, and it attributes this thought to Aristotle’s own treatise *On Problems*.⁶ These commentaries, then, would encourage us to search for a connection between the theory of inquiry presented in *APo.* 2, and the methodology of identifying and proposing answers for problems seen in the Aristotelian *Problems*. As I argued in a 1994 paper entitled “Aristotelian Problems,” the use of the concept προβλήματα in the *Posterior Analytics* is concentrated in four chapters: 2.14–18.⁷ Those chapters in turn depend on a set of techniques for selecting terms that are appropriate for proving particular problems that are described in *Prior Analytics* 1.27–30. I concluded that paper with some historical considerations about the significance of a methodology already at work in Greek mathematics and perhaps referred to in Plato’s *Republic*⁸ to the method Aristotle is proposing and (looking forward) the possible relevance of Aristotle’s work in this area to the 38 books of *Problems* on which the current volume of essays is focused.

Building on the evidence presented in that earlier paper, I will here argue that what is described in these chapters constitutes, as the comments of Alexander and pseudo-Philoponus would lead us to expect, an important *intermediate* stage of scientific inquiry, one which involves moving from “partial universals” to *co-extensive* universals,⁹ the kinds of propositions that Aristotle thinks form

5 Fr. 112 Rose³; Ross (1952, 104).

6 There are many references in the extant corpus of Aristotle to his own collections of problems (sticking just to references to natural problems: *APo.* 1.31.88a12; *Mete.* 2.6.363a24; *Juv.* 5.470a18; *PA* 3.15.676a18; *GA* 2.8.747b5, 4.4.772b12, 4.7.775b37), not to mention the references in the ancient catalogues (e.g. D.L. 5.23.18, 5.26.10).

7 The one other appearance of the term (at 88a12) is the reference, mentioned in note 6, to the collection of problems.

8 *Republic* 6.530b6–c1, 531c1–4. The latter passage refers to geometry and arithmetic investigating such things as which numbers are and are not consonant and why (διδά τῆ) as “ascending to problems.” See Lennox (1994, 73 [2001, 91]).

9 It might be thought that *Top.* 2.1.108b34ff. is relevant here, since it distinguishes between universal and ‘partial’ problems. But Aristotle goes on to explain that the distinction he has in mind is between statements of the form “P belongs to all S” and “P belongs to some S,” not a distinction between non-convertible and convertible universals. That is, however,

the basis of any science, properly so called.¹⁰ Though my primary focus will be on chapters 14–18 of *APo.* 2, I will do so in such a way that their continuity with the rest of book 2, and even key elements in book 1, will become apparent. It is in these chapters, I am convinced, that we find the origins of the idea that formulating problems as *why-questions* about the facts in a given domain is a crucial stage of any scientific inquiry. I will also argue that the grasp of co-extensive relationships among universals is for Aristotle a critical step in focusing the search for causal essences, and that it was for the sake of achieving that step that Aristotle developed a specific logical technique for “grasping problems.”¹¹ Before doing so, however, I want to place my approach within the context of a longstanding tradition of exegesis of Aristotle’s views about the grounding or warrant for first principles.

2 Inquiry as an Epistemological Subject

The concluding section of *APo.* 2.19 (100b5–17) goes beyond the description of the route from perception to universals presented by the preceding sections of the chapter. There we are told that the faculty that knows first principles must have a grasp of them that is *superior* to the grasp we have of anything that follows from them. But the preceding description of the process leading *to* principles is not nearly rich enough to ground a belief that at the end of this process we will have a grasp of first principles with the requisite strength.

exactly what Aristotle has in mind by distinguishing universal and ‘partial’ demonstrations in *APo.* 1.24.

10 There won’t here be space to deal with what Barnes (1994, 258) refers to as “the doctrine of the Commensurate Universal.” Generally, I agree with the view articulated by Charles (2000, 208 n. 20) that *primitive* universals in an Aristotelian science will be commensurate and are of critical importance in the search for causal understanding, as opposed to a much weaker claim defended by Barnes and a much stronger one defended by Zabarella. Charles and I disagree about the precise role identifying commensurate predicative relationships plays in scientific inquiry and the “stage” at which they are identified.

11 The extent to which this is the purpose of at least some of the books of *Problemata* discussed in this volume is debatable, and it is my hope that this paper will at least focus the debate by indicating what to look for in order to decide. A number of the papers in this volume note a tendency to start with a very particular why-question or set of why-questions and to work toward a general answer; and also occasionally to extend the answer to additional cases (see for example, Thomas, pp. 85–94, Fortenbaugh pp. 315–19, Baltussen, pp. 184–86). On the other hand, in her contribution Leunissen stresses particularity in the problems and appears skeptical that these works aim at generality. At the close of the paper I provide a list of features that would be tell-tale signs of the *Problemata* carrying out the sort of program I find outlined in *APo.* 2.14–18.

There is nothing in that description, for example, that provides for even the most rudimentary inductive controls that humans typically use in guarding against erroneous inductive inferences. Nor is anything said about how, among the generalizations achieved, one would be able to identify features *essential* or *causally fundamental* to the kinds at which the process arrives. But without that, we are not justified in claiming we have knowledge of the sort described in *APo.* 1.2. As Myles Burnyeat put it in a classic discussion of the theory of knowledge of the *Posterior Analytics*: “His treatment of this process in B 19 is by our standards perfunctory in the extreme” (1981, 133). Nor has the discussion in *APo.* 2.1–10, of the *stages* of inquiry and the relationship between definition and demonstration at each stage, provided that. Describing the product achieved at each stage of an inquiry, and how each stage differs from the previous, is very different from defending the *correct procedures for achieving* each stage and highlighting the signs along the way that you are on the right track.¹²

In what follows, I outline an interpretation of the chapters immediately preceding 2.19 that sees them as exploring, albeit in a somewhat preliminary and “aporetic” way, difficulties that inquiry faces in moving from factual (τὸ ὄν) knowledge of relatively low level universals to more general, commensurate universals; and exploring questions about how to identify, among commensurately universal attributes of a kind, the causes that will provide answers to inquiries into the reason why (τὸ διότι). As I will argue, these chapters are the origins of a technical concept of scientific problems—factual propositions about which one is seeking an answer to the question, διὰ τί; Aristotle clearly sees this as a critical stage in the process of inquiry aimed at causal demonstration—that is, scientific knowledge, ἐπιστήμη.

3 Scientific Problems

Our primary focus will be on *APo.* 2.14–17; but before turning to those chapters, it is important to provide some context from *APo.* 1. Book 1 presents and defends Aristotle’s concept of demonstrative knowledge. He there insists that determining that some attribute belongs to every member of a kind is a minimal necessary condition for knowing that attribute scientifically. To know some fact scientifically is to have a demonstration of it, and thus the constraints he places on the *premises* of a demonstrative syllogism must be met: those premises must be true, primary, and immediate (i.e. not themselves conclusions

¹² And it is not clear that Aristotle has even done that much: for example, there is a great deal of scholarly disagreement about what one has achieved at the stage that Aristotle refers to as *empeiria*, precisely because he says very little about what it is.

derived from more basic premises), and they must be better known than, prior to, and causally explanatory of the *explanandum* identified in the conclusion. (*APo.* 1.2.71b20–22; these conditions are then explained and defended from 71b26–72b3.) We are told that this will insure that the principles will be appropriate (οἰκεία) to what is to be proven. But what does it mean for the principles to be *appropriate*? It means that the premises of a science that meet the *first* three conditions mentioned above are related to its conclusions in the way specified by the *last* three conditions. In fact the concept of appropriateness (οἰκεία) is first introduced in the *Posterior Analytics* as a way of characterizing the relationship of demonstrative premises to demonstrative conclusions: “... demonstrative understanding in particular must proceed from items that are true, primitive, immediate, and more familiar than, prior to, and causes of the conclusion. In this way the principles will also be appropriate (οἰκείαι) to what is being proved” (71b20–23).¹³ As I noted earlier, there is a serious question for Aristotle’s epistemology of how you could start with a relatively low level epistemic state—say relatively unsystematic experience of a subject—and end up confident that you have knowledge of premises that actually *meet* these very robust conditions.

Two related passages that close *APo.* 1.4 and 5 respectively, deal with just this issue: how does one determine whether a feature holds both *primarily* and *as such* of some subject—this is the mark of an “appropriate” predicative relationship, one “ready” for scientific demonstration; and chapter 5 discusses ways in which we *mistakenly* believe we have grasped such a relationship when in fact we have not—and to some extent what leads us to make such mistakes.¹⁴ It opens, in fact, with the following concern:

It must not escape our notice that we often make mistakes—that which is being proven does not belong as a *primary* universal, though it seems to be proven as a primary universal.¹⁵ We make this error either when there is nothing higher we can grasp apart from the particular case, or when

13 And compare: “For it is not what is reputable that we count as a principle, but rather what is primary in the kind with which the proof is concerned—and not every truth is appropriate (οἰκείον)” (*APo.* 1.6.74b24–26).

14 The connection between being prepared for demonstration and these two properties is made especially clear at *APo.* 1.9.75b37–76a9.

15 I am avoiding the common practice of translating πρῶτον καθόλου, which appears twice here (and again at 74a11 and a12), conjunctively (“primitively and universally,” as do Barnes and Tredennick), since it obscures the fact that Aristotle is characterizing a type of universal predication that is primary and distinguishing it from what he sometimes refers to as what holds κατὰ πάντος (cf. 73b25–28; 74a10–11)—that is, distinguishing convertible from non-convertible universal predication. The common mistake, for which Aristotle is

there is but it is nameless and covers objects of different forms, or when the proof applies to something which is in fact a partial whole. (74a4–10)

It will help to see these two passages together; first from the conclusion of chapter 4:

Something holds universally when it is proved of an arbitrary and primary case; e.g. having two right angles [2R] does not belong universally to figures—you may indeed prove of a figure that it has 2R, but not of any arbitrary figure; for quadrangles are figures but do not have 2R. An arbitrary isosceles *does* have 2R—but it is not primary; triangles are prior. Thus if an arbitrary primary case is proved to have 2R (or whatever), then it belongs universally to this primarily, and the demonstration applies to it universally and in itself. To the other items it applies in another way, not in themselves—it does not apply to the isosceles universally, but extends further. (*APo.* 1.4.73b33–74a4)

I wish to draw particular attention to two features of this passage: first, it describes a *procedure* for finding the subject to which an already grasped attribute belongs *primarily* and *in virtue of what it is*; second, it notes that belonging to all instances of a subject is not sufficient for belonging universally in the primary sense—the attribute must belong to *all and only* instances of the kind. This point is driven home in the conclusion of chapter 5.

Does it [2R] belong to them as triangle or as isosceles? And when does it belong in virtue of this and primarily? And to what does the demonstration apply universally? Clearly that to which it belongs primarily as features are being removed (*ἀφαιρουμένων*); e.g. 2R will belong to bronze isosceles triangle—and also when being bronze and being isosceles have been removed (*ἀφαιρεθέντος*), but not when figure or limit have been. But neither of these is the primary feature. Then what is primary? If triangle, it is in virtue of this that [having angles equal to two right angles] belongs to the other items, and it is to this that the demonstration applies universally. (*APo.* 1.5.74a36–b4)¹⁶

identifying three distinct sources, is of thinking that a mere extensional, non-convertible universal predication is a primary, convertible universal predication.

16 For a good discussion of problems in translating this passage see McKirahan (1992, 172–73); I don't find Barnes' emendation at 74a38 necessary (1994, *ad loc.*). It will be noted that the passive participle of the verb *ἀφαιρέω* appears twice to describe the process of

Here, we learn a bit more about the procedure implicit in the previous passage. You have determined that the figure before you, which is a bronze, isosceles, triangular figure, has interior angles equal to two right angles (2R). But *in virtue of* what, *qua* what, does this figure have that attribute? In virtue of being bronze? If so, a triangle drawn in the dirt should not have it, while any random bronze thing should. In virtue of being isosceles? Then a scalene triangle should not have it. In virtue of being a plane figure? Then non-triangular geometric figures should have it! Eventually you zero in on “triangle” as the kind to which the attribute belongs as such—it is in virtue of being triangular that this, or any, such figure has the property 2R. There are clear procedures for testing each of these options and for finding the subject to which the property in question belongs in itself and as such.

It is important to highlight a feature of these examples that is easily hidden by translation: there is no “kind” that is first identified, after which Aristotle asks, “In virtue of what attribute does this kind have the property 2R?” Rather, there is a presumed object (or group of objects) that is taken to have 2R, about which Aristotle is asking “In virtue of which of a series of *other* features does 2R belong to it?” Is it because it is made of bronze, because all its sides are of the same length, because it is bounded by three straight lines? etc. After this process is successfully completed, an investigator may well decide that since it is in virtue of being bounded by three straight lines that a thing has interior angles equal to two right angles, that all the figures bounded by three straight lines should be designated as a kind—but that would be the *result* of the process here described, not its assumed starting point.

From the first passage, we see that Aristotle’s characteristic way of describing the “isosceles” case is to say that the 2R property belongs to everything that is isosceles but “extends beyond” (ἐπὶ πλεόν) them. We also see in both passages explicit recognition of a *self-correcting procedure* for zeroing in, as it were, on a subject/attribute relation that is *per se* and *as such*: you can test whether a triangular figure has this property because it is a figure by looking at an arbitrary selection of plane figures *other than* triangles, and you can test whether it is in virtue of being isosceles by looking at other kinds of triangles to see whether

cognitively “removing” features to identify which is the first which, being removed, gives you a subject to which 2R no longer belongs. That is significant, since the expression often translated “abstraction” (ἐξ’ ἀφαιρέσεως), based on the abstract noun formed from this verb, is used by Aristotle to refer to the process by which mathematicians ignore or “subtract” the materials and processes of nature in order to focus on a natural object’s mathematical features, *qua* mathematical.

they too have the property.¹⁷ The procedure is necessarily both empirical and comparative.

In these passages, as commentators have noted, Aristotle defines a strong notion of “universality,” which he stipulates in chapter 4: “I call ‘universal’ what holds of every case and in itself and as such” (73b25–26). As he points out earlier in the chapter, you might have proven on different occasions that scalene, isosceles, and equilateral triangles each have interior angles equal to two right angles and thus have proven it of all triangles—but unless you did so knowing that it is *qua* triangular that they have this property, your proofs fall short of providing unqualified scientific knowledge. Chapter 5 opens, as we saw, by identifying three ways in which we can mistakenly think that we have identified premises from which we can demonstrate that a property belongs to something primarily and as such, and closes by outlining a procedure to avoid such mistakes. It also introduces the concept of a *primary* universal.

These two passages in Book 1 suggest, then, that for the purposes of achieving demonstrative knowledge identifying properties of things that are convertible, such as being 2R and being triangular, even when there is no concept to identify all and only the objects with those convertible properties, is very important; and they show that Aristotle has reflected on the problems of identifying features that belong in this way. Moreover, he goes on in chapter 6 to argue that the middle term as well, which identifies the cause in virtue of which these features belong together, must *also* belong *per se* and as such (74b29–32, 75a12–17). I now propose to show that chapters *APo.* 2.14–17 explore how to identify predicative relationships that are universal in this strong sense—primary universals—and explore a number of problems related to identifying *causal primaries* among those predications.

4 What is a Problem?

A “problem” (πρόβλημα) in the context of Aristotle’s *Analytics* has a precise meaning: it is a proposition about which one is seeking, but does not yet have, a proof. Once one does have a proof, the same proposition will be referred to as a conclusion (συμπέρασμα).¹⁸ This explains why the concept appears, in

¹⁷ People familiar with Bacon’s *Novum Organum* will see obvious affinities to his procedure of creating “tables of presence and absence” (Book 2, Aphorisms 11 & 12).

¹⁸ For a full discussion of the background in the *Topics*, see Lennox (1994, 53–57 [2001, 76–91]); for an interesting discussion of the geometric background to Aristotle’s use of this term, see Byrne (1997, 55–62). Surprisingly, since much of this book is a discussion

the *Posterior Analytics*, only in chapters 14–18, for in those chapters Aristotle is discussing difficult questions about the search for universal propositions that are prepared for demonstration and about identifying the causal middle term. These chapters, in turn, are applying, within the context of *scientific* inquiry, modes of analysis developed in *Prior Analytics* 1.27–30. This is only to be expected, for the *Prior Analytics* is the first part of the investigation “about demonstration and . . . of demonstrative science” (περὶ ἀποδείξεων καὶ ἐπιστήμης ἀποδεικτικῆς) (1.1.24a10–11). The transition to a discussion of problems, in the more abstract domain of the theory of the syllogism, occurs at *APr.* 1.26–27:¹⁹

So then, it is clear from what has been said how every syllogism comes about, both through how many terms and premises, and how these are related to each other; and furthermore what sort of problem (ποῖον πρόβλημα) is proved in each figure, and what sort [is proved] in more and what sort in fewer figures. But how we may ourselves always be well supplied with syllogisms related to what is taken up, and through which route (διὰ ποίας ὁδοῦ) we can grasp the principles (ληψόμεθα . . . τὰς ἀρχάς) about each thing, we must now state; for it is not only necessary to study the coming to be of syllogisms but also to have the capacity to produce them. (43a16–24)

In a *demonstrative* context, problems are stated as *why-questions* for which we seek causal explanations,²⁰ and as noted earlier, the *Physics* introduces his four kinds of cause by alluding directly to the wider epistemic context: “we think we have scientific knowledge of a thing only when we can answer the question ‘why?’ (τὸ διὰ τί), and that is to grasp the primary cause” (2.3.194b18–21).

The concept πρόβλημα is first introduced in *APo.* 2.14. This chapter sketches a means of grasping problems by “selecting” information from “dissections and divisions,” in language borrowed from the discussion of selecting terms

of *APo.* 2, Byrne does not recognize the connection of the use of πρόβλημα in the *Prior Analytics* to its use in *APo.* 2.14–18, and thus to the ‘Problems’ tradition in the Lyceum.

19 As is often the case, the chapter division, which occurs half way through this passage, makes very little sense.

20 Indeed, in the “Problems” tradition, which I’m arguing was likely inspired by these chapters of the *Posterior Analytics*, this becomes a trope: virtually every chapter of the 38 books of *Problems* that run from 859b1–967b26 in the Bekker edition of the Aristotelian Corpus (generally assumed to be at least largely due to later members of Aristotle’s school rather than to Aristotle) begins with the expression διὰ τί (why?). I have made some tentative suggestions about how these books may be connected to the distinction, in Greek geometry, between theorems and problems in Lennox (1994) (reprinted in Lennox 2001).

for premises relative to a specific problem in the *Prior Analytics*. Moreover the techniques sketched for selecting flow quite naturally from the long discussion in the previous chapter of using division in the hunt for definitions (13.96b15–97b6).²¹

Aristotle begins with an example that reflects already familiar subjects and attributes, then moves on to unfamiliar cases from his own biological investigations. The familiar example is used to lay out a procedure:

- I. Posit a higher kind common to all the objects being studied, e.g. animal (98a2–4)
- II. Select from your dissections²² and divisions what belongs to all members of that kind, e.g. select what belongs to every animal (98a1–4)
- III. Then select what follows (= belongs to)²³ all of the “first remaining things”—from his examples, he means to select attributes that belong to all the groups one comes to by dividing animal into the most immediate sub-kinds. He mentions “bird” which is one of two examples he consistently mentions as extensive kinds (μέγιστα γένη) of animals appropriately identified in the Greek language (the other being fish).²⁴ (98a5–7)

21 For a clear, though brief, discussion of the methodology outlined in this chapter, see Kullmann (1974, 196 ff.); for a recent contrasting view, see Charles (2000, 239–43).

22 Pace Ross (1949, 663–64), there are compelling reasons to consider the expression τὰς ἀνατομὰς to be a reference to the lost collections of anatomical diagrams, collections referred to 28 times in Aristotle's zoological works and referred to in the ancient catalogues of Aristotle's writings (e.g. D.L. 5.25.15–16; cf. references to collections of Divisions at 23.10–11, 24.6). First, this is the only use Aristotle makes of this term, so that if it had a different sense here it would be unprecedented; second, as we will see, unlike other chapters in the *Posterior Analytics*, all the examples in this chapter are zoological, and the second and third are *technical* examples that require knowledge of animals that can be acquired *only* by wide ranging dissections on many different kinds of animals. The first example, by contrast, draws much more obviously on the language and techniques of division discussed in chapter 13 (96b35 ff.). In fact, the use of “dissection” here may provide some insight into what these works were, since the usage here suggests that the information imbedded in these works was helpful for determining the *extension* of a part relative to other parts.

23 The expressions “select what follows S” and “select what S follows” are borrowed from the *Prior Analytics* chapters referred to earlier, and are roughly equivalent to finding what “belongs to every S” and what “S belongs to every one of” (cf. 1.27.43b1–37, 1.28.44a37–b6, 1.28.44b20–36).

24 See PA 1.2.642b14–16, 1.4.644b1–8; HA 1.6.490b7–9.

He then explains why we are doing this:

For it is clear that *we will already be able to state on account of what* the attributes that follow belong to things that fall under the common kind, e.g. why they belong to man or horse. Let A be assigned to animal, B to what follows every animal, and C, D, E to specific animals; surely it is clear why B belongs to D, for it is on account of A. (98a7–11)

It is important to note that the “explanation” formalized at the conclusion of this passage is *not* a demonstration according to the standards we saw articulated in Book 1: if the conclusion here predicates of one specific kind of animal a property that is common to all animals, it follows that it does *not* belong to the subject of the conclusion “in virtue of itself and as such.” The property *may* belong *per se* to *animal*, but even that is not guaranteed by the method outlined here, since something could belong to every animal because it is a property that belongs to every organism.²⁵

In any case, nothing in this chapter’s introduction led us to expect a demonstration. The chapter is not introduced as a search for *explanations* of problems, but as a method for *grasping* problems. It opens: “In relation to grasping problems (Πρὸς δὲ τὸ ἔχειν τὰ προβλήματα), one ought to select from both the dissections and divisions, selecting in the following way . . .” (98a1–2). Consistent with the focus of *APo.* 2 on the intimate relationship between demonstration and definition, division was discussed in the previous chapter as useful for discovering what things are, and is now introduced in the context of discovering middle terms to be used in explanations.

But if that is the intent, it is once again not obvious how the method that Aristotle here describes fulfills that intention. Certainly there appears to be an unstated background of problems of the form “On account of what does F belong to man/horse?” Moreover, the “selection procedure” described in the first seven lines, however obscure it is in its details, is supposed to provide a list of features that belong to all animals, or perhaps to a sub-set of animals including horse and human being. But all of this appears to be aimed at being able to provide an explanation for the problems implicit in the formalized explanation with which the passage ends.

25 I refer to these as A-explanations in Lennox (1987 [2001, ch.1]); McKirahan as “application arguments” (1992, 177–78). The genus is in the middle term position, so that you explain why some sort of animal has a property by noting that it is a property common to all animals.

W.D. Ross, following the 16th century Paduan Aristotelian Zabarella, gave the following gloss on what is going on: “this chapter is concerned with advice not as to the solution of προβλήματα . . . but as to their proper formulation” (1949, 662). That is a solution to the dilemmas posed by this passage that I have adopted in the past;²⁶ but I am increasingly concerned about the fact that Aristotle nowhere hints that this is what he is up to. However, one line of evidence is clearly in its favor: the proper formulation of problems is clearly one of the primary goals of the chapters following this one. As those chapters clearly demonstrate, Aristotle sees investigation originating with problems close to perception, more familiar to us.

Assuming this line of interpretation, then, Aristotle is indeed outlining a method for grasping problems. The recommendation is to posit the kind common to the various things that are being studied (τὰ τεθεωρημένα), in this case “animal,” and then select features common to every animal. Suppose after consulting the result of dissections you find that hearts are common to every animal.²⁷ There is now a *sort* of answer to your initial problems: Birds and fish have hearts because they are animals, all of which have hearts. But that implies that hearts do not belong to birds *qua* Bird or to fish *qua* Fish. This is an exact analogue of the example we looked at in *APo.* 1.4–5: by coming to recognize that isosceles or scalene figures each have 2R because they are triangles, you are recognizing that 2R is a *proper* attribute, not of these types of triangle, but of triangle as such. It is this convertible predication, 2R—Triangle, that is the subject of a properly formulated problem. And by the search procedure outlined in the first example in *APo.* 2.14, you should be given the materials and methods to get hold of those problems.

But note that, in each case, what Aristotle has not even *hinted* at is *why* all triangles have 2R or *why* all animals have some feature universally—other than to say “because they are all triangles” or “because they are all animals.” In order to answer *that* question, one will need to know something essential about animals or triangles that will explain why these attributes belong to them as such. To this point the “problems”—the why questions about some fact taken as known—are not of the kind prepared for strict demonstration. But by searching for the preliminary *answers* to these problems, we should eventually find *candidates* for strict demonstration, properties that belong (in this case) to animal *qua* animal.

The next two, more technical, examples help to clarify what is going on. The previous example, Aristotle acknowledges, tapped into familiar concepts

26 See Lennox (1994, 64 n. 21 [2001, 82 n. 20]) and (1987, 90–99 [2001 7–15]).

27 Aristotle actually would say “heart or heart analogue.”

drawn from every day experience: bird, animal, horse, human being—he didn’t even bother to identify the attributes in question, only variables. He recommends carrying investigation well beyond such cases.

At present we are speaking according to commonly assigned names, but one ought to investigate not only in these cases, but also if some other thing belonging in common has been observed—selecting it, we should investigate what it follows and what follows it, for example, having the third stomach and lacking upper incisors follows having horns and again having horns follows something. So it is clear why (διὰ τῆς) the identified feature will belong to these, for it is because having horns will belong. (98a13–19)

There is no “kind term” for that which is common in this case; rather we have three verbal phrases—literally “that which has the third stomach,” “that which lacks both upper and lower teeth,” “that which has horns.” The Greek expressions are even ambiguous as to whether they are referring to groups of animals with these features or to the features themselves. But (probably not coincidentally) there is an extensive discussion of the relationship among these three features in Aristotle’s *On the Parts of Animals*.²⁸ What that discussion stresses is that these three properties—multiple stomachs, the lack of upper incisors and horns—are (i) co-extensive and (ii) causally connected. In brief, the explanation offered there is as follows: the production of horns limits the amount of bony material left available for forming teeth, causing the lack of upper incisors; that in turn limits the extent to which food can be masticated, a problem dealt with by means of multiple stomachs (cf. *PA* 3.2.662b35–663a7, 663b28–664a2; 3.14.674a30–b17). Without him saying so, then, what Aristotle has provided here is a *problem* formulated appropriately for a proposed explanation. The possession of horns is identified as the feature on account of which having multiple stomachs belongs to all animals lacking upper incisors—but in our passage, he offers no justification for that choice. That, as we will see, is significant: a major theme running through chapters 15–18 is precisely the question of how to identify, once you have established that a number of properties are co-extensive, which (if any) of them is causally fundamental.²⁹

28 Cf. Gotthelf (1987, 178–85 [2012, 164–71]) and Lennox (1991, 275–76 [2001, 49–50]).

29 This is precisely the issue in terms of which certain counter-examples were posed to the deductive-nomological account of explanation initially proposed by Carl Hempel and Paul Oppenheim in 1948 (for a nice summary of the examples and the issue at stake, see Salmon 1989, 46–50). For example (due originally to Sylvan Bromberger [1962], though

There is a third example in this chapter that is also suggestive and helpful for framing a discussion of the following chapters. It is brief enough to quote in full:

Yet another way [to grasp problems] is to select [predicates] according to analogy. For it is not possible to grasp one thing that is the same which *seption*,³⁰ fish spine, and bone should be named; but there will be things following these as well, as if there were some one nature of this sort. (98a20–23)

Because each of these internal, bony structures is found in different great kinds (cephalopods, fish, quadrupeds) these structures will only be analogues. But if one searches among the features predicated of each of them, one may find features they have in common and consider whether they are due to a common cause. In fact Aristotle thinks these parts are *materially* alike, and that the material likeness provides them with the ability to play a “skeletal” role in the three different kinds.³¹ And thus there may be a common explanation for their presence in each of the three kinds, even though they are only one by analogy. That is, beginning with problems such as “On account of what do sepia have a *seption*?” or “On account of what do land animals have bones?” you may find a common answer, even though there is no common kind to be identified as there was in the first example.

Chapter 14, then, appears to take as its starting point the idea that a certain problem has been identified, and you are in search of an explanation. Its focus is on identifying a set of procedures for finding a middle term relative to that problem. In some cases the subject of the problem will belong to an already identified kind and you can take that as your starting point. Making use of knowledge embedded in catalogues of divisions and dissections, you search

according to Salmon, 189n12, this precise example never appeared in publication), given light shining on a flagpole of height h at a given angle a , there will be a shadow of length l . You can deduce the length of the shadow from the height of the flagpole and vice versa. But since the interaction of the light and flagpole determine the length of the shadow, while the shadow is not similarly implicated in determining the height of the flagpole, there seems to be more to explanation than mere deducibility. Aristotle, as we will see, discusses a number of similar examples.

30 An evolutionary remnant of the shell found in most species of cuttlefish; cf. *HA* 4.1.524b23–30, 4.7.532b1.

31 “There is even an analogue to the spines of fish in the soft-bodied animals; for example, in the sepia there is a part called the ‘*seption*,’ in the squids what is called the ‘sword’ ” (*PA* 2.8.654a20–23).

for attributes that belong to every member of that kind and that to which that kind belongs, relying on the method of division for “hunting down the what is it” discussed in the preceding chapter. If no kind has been identified relative to the problem you are working on—say, “On account of what do animals with no upper incisors have multiple stomachs?”—you can still use the method of asking what the subject belongs to all of and what belongs to all members of that subject class. Even when the features in need of an explanation are only analogous, one should look to see if they have attributes in common, for they may have a common explanation.

Chapter 15 is focused on characterizing ways in which different problems may be related to each other.³² Aristotle distinguishes three types of case and in each case how the middle terms proposed as the explanantia are related is the key:

Case 1. Once one identifies a middle term for initially distinct problems, it may turn out that the middle term is the same. His “example” here is unhelpful because he doesn’t identify the distinct problems, but only says that one might discover that the explanatory middle in all cases is “mutual displacement.” Should this turn out to be true, it could lead you to the conclusion that these apparently distinct problems are actually instances of one, more abstract problem. Though the example here is not spelled out enough to be helpful, Aristotle has dealt with this very problem before, in *APo.* 1.5. That chapter is devoted to discussing cases in which, for a variety of reasons, one may fail to identify the appropriate universal subject for an unqualified demonstration. One of those reasons is that there is a universal common to the distinct problems, but what they have in common lacks a name and so has not been identified. His example is apparently taken from recent history—a recent discovery by his colleague in the Academy, Eudoxus.³³

That what is proportional alternates, though at one time proved separately as numbers, as lines, as solids, and as times, can be proven of them all by one demonstration; but due to all these things—numbers, lengths, times, solids—not being given some one name and differing in form

32 One thing that is relevant to determining whether these chapters set the agenda for the tradition represented in the 38-book collection of problems is whether there are consistent attempts in those books to discover these sorts of relationships among initially distinct problems. I will conclude this paper by considering what we should be looking for in order to answer this question.

33 The scholium to Euclid, *Elements* 5 says that the general theory of proportion presented there is due to Eudoxus. See Heath (1931, 190–91).

from one another, they were grasped separately. But now it is proved universally; for it is not *qua* lines or numbers that alternation belonged, but *qua* this, which is posited to belong universally. (74a17–25)

In fact Aristotle uses this very example to illustrate how problems may be alike and different in different respects in 2.17:

For example, why do proportionals alternate? For the cause in the case of lines and of numbers is different, and yet the same—*qua* line, different, but *qua* having such and such an increase, the same. (99a8–10)

Here we see the *alternando* theorem treated as a problem—why do proportionals alternate? Aristotle is suggesting that there are in fact problems at the specific level that will have specific causal explanations appropriate to that level, but a more general problem and a way of characterizing the cause such that it is the same for both problems. Many problems at the lower level become unified at the higher level.

Case 2. In some cases the problems may be genuinely different, but *generically* the same.³⁴ Here his example *is* helpful. Suppose you are concerned to solve the following three problems:

- a. Why are their echoes?
- b. Why do mirror images appear?
- c. Why do rainbows occur?

Each of these is genuinely different, but Aristotle notes that they all involve reflection—“all these are the same problem in kind (for all are [cases of] reflection), but are different problems in form” (*APo.* 2.15.98a28–29). I take it that what distinguishes Case 2 from 1 is that here the types of reflection in the three examples are really different: there is no sense here that we mistakenly thought these were different phenomena but an advance in knowledge has shown us they are in fact all the same. Rather, sound, sunlight and patterns of shape and color can be reflected, but the form of reflection is very different.³⁵

34 It is unclear to me how different these cases are from those of type 1. Notice that in *APo.* 1.5 Aristotle refers to the four types of proportionality as “different in form,” and in 2.17 says that *qua* line or number the cause is different but *qua* having a certain type of increase the cause is the same.

35 In a similar context in *PA* 1.1.639a19–b3, Aristotle distinguishes features, such as forms of locomotion, that are generically alike in animals but that “differ by a difference in form,” from features, such as sleep and respiration, that are the same across kinds.

Case 3. Finally some problems are related because, while they are different, the middle term that is the answer to one is not “immediate”; it is subordinate to the middle term that answers the other. Again he provides an example, one that is again related to a complex and fascinating history:³⁶ “Why does the Nile flow more when the month is ending? Because there are more storms when the month is ending. But why are there more storms when the month is ending? Because the moon is waning” (*APo.* 2.15.98a31–33). Here the two *problēmata* are: “Why is there increase flow in the Nile at month’s end?” and “Why are there more storms at month’s end?” For the sake of illustration, Aristotle asks us to imagine that the increase in flow is due to an increase in storms, and that the increase in storms is due to the waning of the moon, presuming (I suppose) that the moon’s waning has some effect on the atmosphere. It is noteworthy that what is a *premise* in the explanation of the first problem becomes the *problem* to be explained in the second. Though Aristotle’s language of one middle term being “under” another may imply this, he never states that what this example displays is a search for a more fundamental or immediate cause. In fact, it seems likely that in this case the moon’s waning would be appropriate as an explanation for the periodic occurrence of storms, but inappropriate, because too remote, as an explanation for the flooding of rivers generally, let alone a particular river.

What unites the discussions, in Cases 1–3 above, of the ways in which distinct problems may be related is the methodology by which one goes about discovering *that* distinct problems are related, and *how* they are related. These discussions all presuppose a context of inquiry, that is, a *process of question-driven causal search*. And that context leads Aristotle immediately to his next philosophical issue. For what is, in our modern editions, the next chapter opens with the following *aporia*:

Concerning a cause and that of which it is a cause one might be puzzled whether, when the effect (τὸ αἰτιατόν) is present, the cause (τὸ αἷτιον) is also present (so if there is a shedding of leaves or an eclipse, the cause of

36 See the essay by Stephen Menn in this volume, pp. 16–17. A work attributed to Aristotle on this subject is preserved only in a 13th century Latin translation, *Liber Aristotelis de inundatione Nili*. For a text with English translation and commentary, see Aubert (2014). For a thorough discussion of the history of this text, who the original translator may have been, and its authorship, see Beullens (2014). The connection between this manuscript and the passage we are discussing is by no means direct. The problem which *De inundatione Nili* discusses and presents an explanation for is why the Nile floods in the summer rather than the winter, whereas in *APo.* 2.15 the problem is why the Nile increases in flow level at the end of each month.

there being an eclipse or a shedding of leaves will be present; e.g. if this is the possession of broad leaves or, of the eclipse, the earth being in the middle; for if it is not present, some other thing will be the cause of these things); and likewise, if the cause is present at the same time the effect also [is present] (e.g. if the earth is in the middle an eclipse occurs, or if broad leaves, leaf shedding occurs). (16.98a35–b4)

What, precisely, is the *aporia* about which Aristotle is concerned? The puzzle is Aristotle's version of the classic "length of shadow-height of flagpole" problem referred to earlier—if the two properties are truly commensurate, how do you decide which is explanatory of which? One can see that this is the concern by looking to the next sentence in the text: "If this is how things are, [cause and effect] would be simultaneous and could be proved through one another" (98b4–5).³⁷ This is a concern that has already been discussed in *APo.* 1.13, in the context of distinguishing two different kinds of demonstration, one proceeding "through the fact"³⁸ and another "through the reason why." Aristotle's concerns, in a nutshell, are two: First, is there something in the nature of the relationship between cause and effect that *requires* that they be commensurate? And second, once one has arrived at the stage of an inquiry achieved by the previously described "problems" method, where you have identified a number of properties that are appropriately commensurate, how do you take the next step of identifying which of these two terms refers to the property that is causally fundamental and explanatory of the others?

He first illustrates his concerns by means of a demonstration in which the problem is at the lower, non-commensurate level of universality: Why do grape vines lose their leaves? The example is:

Shedding Leaves: A Broad-Leafed: B Grape vines: C
A belongs to all B, B belongs to all C, therefore A belongs to all C. (98b5–10)

³⁷ Barnes translates the verbs as simple futures, but in fact they are potential optatives, and since this concern is raised in the midst of stating an *aporia* and is the apodosis of a conditional, it is preferable to make the modal force explicit. It is also important to note that the verb is δείκνυμι, to show or prove, not ἀποδείκνυμι, the verb he uses for scientific demonstration. It is possible to construct a proof with either the cause or the effect in the middle term position—but only one of those proofs will be a *demonstration*, in which the middle term identifies the cause.

³⁸ It is non-standard for Aristotle to use ἀπόδειξις for such cases, since the proof that has the more familiar, non-causal middle term does not meet the criteria for unqualified demonstration as he has defined it in *APo.* 1.2–6. There are a number of such uses in the *Posterior*

Here, while B is assumed to be the middle term, A and B are commensurate with one another, and both are of wider extension than C. He then notes his worry: "But you can also demonstrate that vines are broad-leafed by way of the fact that they shed their leaves. . . . Hence every vine is broad-leafed and shedding is explanatory" (98b16–17). That is, since A and B are commensurate, why are we taking B to be the causal middle term? Notice that, once again, the problem arises because we have been given no criterion by which to determine, when we have identified a commensurately universal connection, whether it is a *causal* connection—nor, if it is a causal connection, which of the related attributes is the cause and which is the effect.³⁹ But this passage does assume that the connection between being broad-leafed and shedding leaves seasonally is a commensurate one, and the example takes it for granted that one of the two commensurate terms is the cause of the other. Moreover, the "demonstration" that he is using by way of illustration is not an unqualified, or B-type, explanation. Whichever of the commensurate terms you use for your middle term, it is wider in extent than the subject of the conclusion. So in effect this example has only illustrated a case where we have moved the inquiry to the right level of universality to search for the cause of the robust connection between being broad-leafed and leaf-shedding.

Is there, then, any indication in these chapters of how, at an *earlier* stage of inquiry, that commensurate relationship might be identified? As it happens, yes. At the end of chapter 16, picking up on the leaf-shedding example, Aristotle begins to move toward a resolution of these issues. He asks: "if *problems* are always universal and the cause is something whole, then must that of which it is the cause also be universal?" (98b32–33) He urges us to an affirmative answer:

For example: shedding leaves is determined to some whole, even if this has forms, and it holds of these universally (either of plants or plants of a certain form). Hence in these cases the middle term and that of which it is the cause must be equal [in extension] and convert. For example, why do trees shed their leaves? If it is because of solidification of their moisture, then if a tree sheds its leaves solidification must hold, and if solidification holds—not of anything whatever but of a [sort of] tree—then the tree must shed its leaves. (98b33–37)

Analytics, and they often seem to refer to cases where, at a certain stage of inquiry, one could *think* that one had produced an unqualified demonstration.

39 Or, as he imagines in the next chapter, whether the connection between them is due to a common cause.

Without fanfare, the “middle” that would provide an interim explanation for why various forms of broad-leafed trees shed their leaves—being broad-leafed—is now (implicitly) the minor (subject) term in the conclusion, and a material/efficient cause takes up residence as the causal middle. As in all the examples in these chapters, Aristotle has sketched a cognitive ascent to a level where subject and predicate in the conclusion are commensurate and a new middle term is identified as the cause. What had been taken as the cause when this example first appeared—being broad-leafed—is now identified with the sort of tree that sheds its leaves, and solidification of the moisture (presumably sap) is identified as the cause of such “trees” losing their leaves.

Near the end of his discussion of the search for explanations relative to specific problems, he fleshes out this example considerably, comparing it to a geometric example of a property (external angles equal to four right angles) that belongs to both triangles and quadrangles but extends beyond them.

The cause, that of which it is the cause, and that for which it is a cause are interrelated in this way. If the subjects are taken case by case, the effect has a wider extension (e.g., having external angles equal to four right angles extends further than triangle or quadrangle); but if they are all taken together, the effect is equal in extent . . . ; and likewise with the middle term [i.e. the cause]. *And the middle is the definition of the first extreme, which is why all sciences come about through definition.* For example, shedding of leaves follows every grape vine, and extends beyond, and follows every fig tree and extends beyond, but it does not extend beyond all. *Indeed if we grasp the primary middle, it will be an account of leaf shedding.* For there will be a first middle in the one direction (that all are such and such); and then a middle for this (that sap solidifies, or some such). *What is the shedding of leaves? The sap solidifying in the connection with the seed.* (APo 2.17.99a16–29; emphasis added)

The reader should again be reminded of the examples in APo 1.4–5. One could imagine a young Greek growing up on a vineyard and watching the vines lose their leaves year after year, eventually concluding that this is a property distinctive of grape vines. At a certain point in his life he visits places with fig trees and sees that they do as well, and gradually learns that many plants do this. He begins to consider whether they all have something in common that causes this to happen, and realizes they all have broad leaves.⁴⁰ At this point he

40 It is important to note here that in a passage I won't be able to discuss, 99a30–b7, Aristotle considers the important question about whether the same effect could have a different

may posit this as the cause of shedding. But at a later stage of research a new problem may occur to him: *Why* do all broad-leaved trees lose their leaves? And that leads to a search for what precisely happens to the broad-leaved plants at the time of the year when they lose their leaves. When Aristotle says that there will be “a first middle in the one direction,” I take it he is referring to the identification of the appropriate subject of shedding leaves—being broad-leaved—that initially serves as the middle term in accounting for why specific *kinds* of broad-leaved plants shed their leaves. This interpretation is confirmed by him next saying that there will be a middle “for this”—i.e., for the commensurately universal problem of *why* broad-leaved trees lose their leaves. Here Aristotle also ties his discussion of finding problems appropriate for causal demonstration back to the account of the relationship between definition and demonstration in *APo.* 2.8–10: he concludes by simply stating that the causal middle of the demonstration will also be a definitional account of the explanandum. As it was with eclipse and thunder, so now it is with leaf-shedding.⁴¹

5 Looking towards the *Problemata*

If there are significant connections between these chapters and the 38 books of the *Problemata* included in Bekker’s edition of the Corpus Aristotelicum, there ought to be evidence that goes well beyond the fact that they each are factual statements about which the question διὰ τῆς is asked. I conclude by listing the sort of evidence that we should hope to find, at least occasionally, in the discussions and proposed solutions to those problems.

1. Particularly in ch. 14, but implicitly throughout all four chapters, there is a presumed background of information hierarchically organized in divisions, such that one can easily identify universal predicative relationships between the subject of the problem and items on these lists. Is there, then, in the *Problemata*, evidence that those who are “working” on a problem are making use of information organized in this way?

cause in different kinds—e.g., could being long-lived be due to different causes in four-legged land animals versus birds (99b4–7)? Though it appears he leans toward supposing that either they are not really the same effect if the cause is truly different or though named differently they actually are cases of the same effect, he appears to leave the question open.

⁴¹ This interdependency of definition and causal demonstration is one of the primary themes of Charles (2000). He discusses its appearance in *APo.* 2.16–17 on pp. 204–209.

In particular, is the language of “selecting from divisions” and looking for “what follows X and what X follows” in use?

2. Chapter 15 outlines three different ways in which different problems can nevertheless be related, such that by looking for and finding these relationships we work our way toward more fundamental causal relationships, and in certain cases identifying appropriately commensurate relationships prepared for unqualified demonstrations. Is there evidence in the proposed “answers” in the *Problemata* that the authors are searching for these sorts of relationships among distinct problems?
3. Chapters 16 and 17 assume that inquiry will or has reached the stage where the subject and predicate of the problem for which we are looking for a causal explanation are commensurate, and there is a long, aporetic discussion of whether, in such cases, the cause must also be commensurate with the subject and predicate of the problem. In discussing that issue, a number of examples are used to trace cognitive progress from treating a property, which is commensurate with some attribute that belongs to a number of different kinds, as the cause of its presence in those kinds to treating the purported cause and effect as the problem, and a more fundamental cause of that commensurate relationship is proposed. Being broad-leafed goes from being the cause of leaf-shedding belonging to various kinds of trees to being the subject of a more abstract, convertible, problem. Are there examples in the *Problemata* of this sort of cognitive ascent, or at least of the search for these more fundamental problems?

These chapters of the *Posterior Analytics*, as I have been insisting for many years, provide crucial evidence for how Aristotle understands the advance of research on a subject from perceptual experience, which serves as the foundation of scientific knowledge of a domain, to a grasp of the fundamental causal relationships that hold in that domain. They are also evidence that formulating problems, proposing explanations for those problems, and moving to the level where the problems related to a subject involve subjects and attributes that are commensurate—primary universals, as Aristotle calls them—is an important step toward identifying scientific first principles. If the answers to questions 1–3 above are positive, then the *Problemata* carry on a central aspect of scientific inquiry as it is represented in the *Posterior Analytics*.⁴²

42 I take this opportunity to thank Andrea Falcon for many enjoyable discussions about Aristotle's discussion of ‘problems’ in the *Analytics* and how that discussion might be

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The *Problemata*'s Medical Books: Structural and Methodological Aspects¹

Katerina Oikonomopoulou

One of the most intriguing features of the pseudo-Aristotelian collection of *Problemata* concerns the prominence of medical information in its content: medical topics are mostly concentrated in two extensive groups of books, namely, 1–11, and 31–38, which are placed at the head and conclusion of the collection, respectively. This arrangement possibly hints at a deliberate plan to make the medical enquiries distinctive, although the reason for this is never openly proclaimed.² On the other hand, although it is clear that the authors of the *Problemata* took care to organise medical problems into books according to topic (ranging from the origins of health and disease, to investigations concerning therapy, pharmacology, physiology and anatomy), it is harder to determine the relationship of the individual medical books, as well as of the individual problems that comprise each medical book, to one another. Indeed, more often than not the medical books, far from offering an orderly exposition of their respective topics, give the impression of disjointed assemblies of heterogeneous causal enquiries.

My main concern in this chapter will be to draw attention to some key elements of structure and method that are common across the *Problemata*'s medical books. That is not to say that I wish to underplay the differences between them: like the *Problemata* as a whole, the medical books are products of progressive accumulation, rely on different sources, and reflect the approaches of different scientists.³ What I hope to clarify however are some important

1 The completion of this chapter was possible thanks to the support of the Alexander von Humboldt Foundation, and the research programme “Medicine of the Mind, Philosophy of the Body: Discourses of Health and Well-Being in the Ancient World,” directed by Philip van der Eijk at Humboldt University Berlin (of which I was a member between February 2012–February 2014). I would like to express my gratitude to all my colleagues in the programme, as well as to Stephen Menn, for the interest they showed in my research, as well as to the most helpful feedback they offered on different aspects of my work on the pseudo-Aristotelian *Problemata*.

2 Flashar was the first to note this ring-like schema (1962, 318–20).

3 See Flashar (1962, 323–25), Louis (1991, 1: xxx–xxxv).

questions pertaining to the criteria that dictate the selection and organisation of medical knowledge within the work, and the broader intellectual goals served by its exploration of medical topics. It is hoped besides that the answers will, at least in part, help shed light on the *Problemata's* internal economy as a text which is all too often dismissed as a mindless compilation. The necessity of such a line of study is felt all the more strongly if we consider the work's rich afterlife: in subsequent centuries it spurred the writing of other collections of medical and naturalist problems, thus ensuring the transmission and dissemination of a key segment of ancient scientific thought.⁴

1 **The Cohesion of the *Problemata's* Medical Books: Topics and Macrostructure**

The *Problemata's* choice and distribution of medical topics is unique within the extant corpus of Greek and Latin medical and scientific writing, and does not correspond to any known divisions of the medical art. Only the very first book explicitly associates itself with medicine, through its title: ὅσα ἰατρικὰ (“enquiries pertaining to medicine”). The heading is apposite, as the enquiries focus on the causes of health and disease (problems 1–2, 5, 7) and the connections between disease and environment (problems 3–4, 6, 8–29), concluding with a section on pharmacology and therapeutics (problems 30–57).⁵ Of the ten books that follow, seven collect rather specialised enquiries, on physiological phenomena and conditions connected with sweat (book 2), drunkenness (3), sex (4), fatigue (5), bodily position (6), chill and shivering (8), scars and bruises (9). It is their interest in different functions or states of the human body that justifies our characterisation of these books as “medical,” along with the fact that they align with the interests of the first book, insofar as they too explore the physiological mechanism behind the phenomena in question, enquire after pathological conditions and/or therapeutical prescriptions associated with them, and discuss the role of the environment.⁶ Books 7 (on sympathies) and 10 (on animal biology, comparing humans and animals in terms of their reproductive habits, character of offspring, general physical or behavioural attributes, and organic functions) discuss the human body in terms of its analogous functions to other physical bodies, animate and inanimate. In book 11, finally, enquiries on the human voice alternate with discussions of phenomena

4 See De Leemans and Goyens (2006).

5 On book 1, see Flashar (1962, 385–86), Louis (1991, 1: 1–8), Ulacco (2011), Mayhew (2012).

6 Cf. Marengi's selection (1965): books 1–9, 14, 31–38.

such as the echo and sound, thus opening the ground for the predominantly naturalist investigations that will follow (in books 12–30).⁷ The human body re-surfaces as the focus of investigation in the last eight books, which concentrate on different anatomical parts: the eyes and vision (book 31), the ears (32), the nostril (33), the mouth (34), touch (35), the face as a whole (36), the body as a whole (37), and complexion (38).

A more detailed consideration however allows us to gauge some principles of selection and organisation that enable appraisal of the medical books as results of thoughtful planning on the part of the *Problemata's* authors and redactors. In the first instance, we may note that standard topics of ancient medical literature, such as surgery and gynaecology, are almost entirely absent from the *Problemata's* medical books, as are anatomical investigations concerned with the internal parts of the body (such as the bones).⁸ Similarly, therapy and dietetics (foods, regimen and pharmacology) only have a presence (most prominently, in the first and third books) insofar as the properties of drugs and foodstuffs, and their interaction with the human body are concerned; practical prescriptions on regimen and healing are on the whole absent. Secondly, the opening group of medical books appears to move from a general first book on medicine, to more narrow-focussed physiological investigations, while in the closing set the progression is from specific anatomical parts located at the top of the body (the head) to the whole face, the whole body, and complexion (again pertaining to the entire body). In addition, the topics treated in the second group of medical books in part echo or reduplicate those of the first group: such is especially the case with the enquiries concerned with vision in book 31 (31.2, 4–11, 14–17b, 19–22, 25–28, reminiscent of similar discussions in book 3),⁹ shuddering (33.16, 18; 35.1, 3, 5, 9, 37.4, reminiscent of similar or identical discussions in book 8),¹⁰ discussions of the role of the environment and sweating in books 37 and 38 (37.1–3; 38.1, 3–8, reminiscent of similar discussions in books 1 and 2, respectively),¹¹ and others.¹² Thirdly, books 1, 7, 10 and 11, as we saw, explore the human body in close interaction with its natural

7 Moreover, these books encompass topics falling under the scope of letters (book 18), music (19), meteorology (23–26), and moral theory (27–30).

8 Cf. the Hippocratic corpus (see treatises *On Fractures*, *In the Surgery*, *On Joints* and *Mochlicon*, *On Female Nature*, *Female Diseases*, *On Sterile Women*, *On the Excision of the Foetus*), as well as other medical authors, such as Diocles (see frs. 17–24c, 160a–167, 168–75 van der Eijk), or Soranus (*Gynaecology*).

9 E.g. 3.9–10; 20; 30.

10 8.8, 8.12–13, 8.15, 8.19, 8.21.

11 As noted by Mayhew (2011, 2: 411), in the case of book 37.

12 E.g. 31.26 (cf. 10.50), 33.10 (cf. 10.18, 54).

environment, or compare its functions with those of other bodies, thus putting the focus on its place in the broader order of nature (note especially the title of book 10, ἐπιτομή φυσικῶν [“epitome of natural problems”], which underlines that biological functions constitute part and parcel of the investigation of nature).¹³ Last but not least, thematic overlaps between medical and naturalist books further consolidate the impression that their discussions are meant to be examined in close conjunction. Thus, the climate, water, winds and their impact on humans are discussed not only in book 1 but also in book 14¹⁴ and in the meteorological books (23–26); while discussions of phenomena connected with the sea are not limited to book 23, but also include enquiries into the ears of divers in book 32 (32.2–3, 5, 11).

The limitations imposed to the range of medical material selected for inclusion must surely be purposeful, given that *Quellenforschung* has demonstrated that the authors of the *Problemata*’s medical sections were in contact with a rich background of medical, biological, naturalist and historical sources.¹⁵ If so, it would speak of a method of selection that sought to serve the aims of a theoretical study of medicine, leaving aside its more practical aspects. This is fully in tune with the underlying concern with highlighting, at key points, areas of convergence between medicine and naturalist investigation; and it must also be intrinsically connected with the fact that medical topics act as a frame to the collection as a whole, with the second group of medical books being, in certain respects, the mirror-image of the first. We may recall Aristotle’s circum-spect attitude to medicine in two well-known passages of the *Parva naturalia*, according to which natural science and medicine can overlap in terms of their interests, but only up to a certain degree: the natural scientists conclude their investigations with the study of medicine, while the doctors who practice their art in a more philosophical manner base their theories on the principles of natural science (οἱ μὲν τελευτῶσιν εἰς τὰ περὶ ἰατρικῆς, οἱ δ’ ἐκ τῶν περὶ φύσεως ἄρχονται περὶ τῆς ἰατρικῆς, *De sensu* 1.436a20–b2).¹⁶ The *Problemata* may well

13 See Flashar (1962, 503–504), Louis (1991, 1: 149–55), Mayhew (2011, 1: 279–81).

14 Marengi (1965) includes it among the medical books.

15 On the *Problemata*’s sources, see (in overview), Flashar (1962, 333–41), as well as individual commentary sections. On the use of Hippocratic sources in particular, see Bertier (1989), Jouanna (1996a) and (1996b), and Thomas in this volume. See also Ulacco (2011, 66–80).

16 Cf. parallel statement in *Resp.* 480b22–31. However, these views are not the full story, as we know that the philosopher in all likelihood wrote extensive works on medical matters. The surviving lists of Aristotle’s works attribute to him works entitled ἰατρικά (in 2 books: D.L. 5.21 #110), περὶ ἰατρικῆς (in 2 or 6 books: Anon. #110), προβλήματα ἰατρικά (in five books: Ptol. #70). See Moraux (1951, 110–111, and frs. 373–79 Rose³, 353–62 Gigon. See Mayhew (2012), on book 1’s possible ties to those lost works. On Aristotle’s and his pupils’ interests

be seeking to respond to this Aristotelian position, its macrostructure drawing special attention to medicine as a field that, while distinct from that of natural science, can nevertheless contribute helpful insights to the broader investigation of nature.¹⁷

2 The Cohesion of Problems within (and Beyond) the Medical Books

The *Problemata's* contents tend to be punctuated by loosely-knit units of thematically-related enquiries, which usually do not fully encompass all of the thematically-similar material in a single sequence, but are interspersed across the length of a single book. In the first book for example, problems 1–4 and 13–16 deal with the topic of change generally, while problems 8–12 and 17–29 discuss specific environmental conditions that produce disease; problems 40–43 and 47–48, finally, deal with drugs that loosen or purge the stomach and bladder. Similarly, in the fifth and eleventh book, problems 5.15–20, 5.23–26 and 5.39–41 explore fatigue in connection with running and walking, and 11.35–36 and 54–55 discuss stammering, respectively.¹⁸ Such a meandering sequence might be tied to the cognitive processes and patterns of scientific research that were adopted by the different authors who gave input to the *Problemata's* medical books: free to take up, develop in different directions, or re-consider various lines of enquiry, they left a vast record of overlapping sets of problems and solutions on select medical topics, which were however never distilled into a tightly focussed, methodical exposition, of the kind that we find in Aristotle's biological works.

Yet despite their disjointed format, the *Problemata's* medical books must have afforded opportunities for productive reading throughout their afterlife, otherwise they would never have inspired the composition of later collections of medical-naturalist problems which, far from seeking a more orderly

in medicine, see Longrigg (1995), Lombard (2004), van der Eijk (1995) and (2005, 139–275), van der Eijk and Francis (2009).

17 Flashar attributes medicine's special position to the medical point of view that, in his view, runs through the *Problemata* as a whole (*durchgehende[...] medizinische[...] Betrachtungsweise*; 1962, 330). The opposite seems to be the case, however: what I believe is at stake is the integration of medicine into a naturalist's point of view, hence the fact that the work's medical topics are approached from a theoretical standpoint.

18 Cf. also 31.12–13 (on the senses on the right), 15–16 (on shortsightedness), 17a–b (on double vision), 26–27 (on strabismus); 32.2–3, 5, 10–11 (all on the ears of divers); 34.7–9, 11–12 (on breathing).

exposition, aimed at reproducing the *Problemata's* miscellanistic surface.¹⁹ I argue that one of the advantages of the medical books' format lay in the ability to encourage comparative appraisal of problems, solutions, or specific arguments. In their current version, this is achieved in the first instance through the use of internal cross-references. These are usually introduced with two standard formulas, namely, "this is the same problem" (ταὐτὸ δ' ἐστὶ πρόβλημα), or "to this we shall give the same answer that we gave to the previous problem/the problem above" (καὶ περὶ τούτου ταὐτὰ ἐροῦμεν τῷ προτέρῳ/ἐπάνω). In addition, the passive verb εἴρηται ("it has [already] been stated") is used in order to denote that a specific argument or theory that has already been offered is relevant in the context of a new answer as well. Thus, problems 2.37 and 2.39 both direct their readers to problem 2.36's answer, the former by referring to it with the phrase τῷ προτέρῳ (which underlines the close sequence of the two enquiries), and the latter with the phrase ἐπάνω, which serves as a pointer to an earlier, but not immediately preceding, part of the text. Problem 3.13 cross-refers to the conclusion of the previous one (3.12), namely, "that drunkenness is due to the upper parts being heated has been stated (εἴρηται)," as fundamental to its own argument that the anti-intoxicating properties of sweet substances (including sweet wine) consist in their sticky quality, thanks to which they block the passages (πόροι) through which the wine's heat rises up (872b34–873a1).²⁰ Finally, problem 3.22 adduces as part of its explanation why well-mixed wine causes more serious hangovers than the unmixed variety the argument that unmixed wine has the ability to concoct everything else, which leads, in turn, to the closing statement "this is the same problem." The statement cross-refers to the immediately preceding problem (3.21), whose investigation of why the stomach becomes drier (rather than moister) when one drinks a lot hinges upon the question how the body concocts wine, depending on the quantity in which it is consumed (the answer is that large quantities of wine are not concocted by the stomach, but end up in the bladder). In this instance, then, the cross-reference serves to underline the scientific process that is central to both problems' explanations, namely, concoction. (Cf. 5.39–40.) In this way, internal cross-references highlight the applicability of certain explanations or arguments across enquiries, thus drawing attention to the latter as parallel, or overlapping manifestations of the same phenomenon.

Secondly, the use of associative transitions ties even thematically unrelated problems together, prompting their examination as interconnected units,

19 See Oikonomopoulou (2011), on Plutarch's *Sympotic Questions*.

20 Cf. 3.9–10, 4.23–24, 10.22–23, 11.6.899b9–10, possibly cross-referring to 11.3.899a13, with the phrase: ὥσπερ καὶ δηπύρηται.

rather than as standalone enquiries. A characteristic example is afforded by the first five problems of book four (on sexual intercourse). The opening three discuss sex in connection to the eyes and vision (why it is that, during intercourse, the eyes are cast upwards (4.1); why they sink (4.2); why they lose their sharpness (4.3)). Next, the discussion proceeds to the question of why hair growth accompanies sexual maturity in humans (4.4), and why being barefoot may not be beneficial when having sex (4.5). The common thread, namely, the focus on different anatomical parts of the body, is clear enough. But there is also a subtler network of associations underpinning the transition from one problem to the next: on a broad level, we note a movement from the uppermost parts (the eyes) to the lowermost (the feet), which, if we study the problems more closely, is foreshadowed by the discussion of the eunuchs' swollen legs and loosened bowels (due to the transference of their body's moisture downwards) in problem 4.3 (876b31–32); as well as by the discussion of hair, which probably implies both facial and pubic hair, in problem 4.4 (876b33 ff.). Problems 5.35–37 provide another example. Even though they treat independent topics under the umbrella of the book's wider theme, fatigue, these lead to one another via associative links: thus, 5.35 brings up the issue of irregular walking, alternating between pauses and movement, as responsible for why short walks are fatiguing;²¹ 5.36 picks up on 5.35's reference to bodily movement, and seeks to explain why it is heat-producing. 5.37, in turn, follows up on the reference to the cold air at the end of 5.36: there, it is mentioned as the factor that cools the body of somebody who walks; now, it is thought of as the cause behind the riders' and runners' tears. In other medical books as well, problems which treat different topics can succeed one another on the basis that they invoke a similar explanation (for example, 10.1 and 10.2 attribute coughing and blood flow from the nostrils (respectively) to the same physiological process, namely, the fact that humans have the largest and moistest brain), or by means of antithetical thinking (for example the thin blood in 10.2, leads to reflection on thick flesh in 10.3, the thick flesh of women and children in 10.4, and the thinner skin of humans in comparison with that other animals in 10.5).²² In this way, associative links put into relief key concepts (the body as a series of interlinked parts, the moist brain, the role of heat and cold) that carry special significance for

21 The problem is based on Thphr. *Lass.* 14–15. See Fortenbaugh et al. (2003) ad loc.

22 The technique of association is more familiar to us from imperial problem-collections (namely, Plutarch's *Sympotic* and *Natural Questions*, the *Medical Problems* of pseudo-Alexander of Aphrodisias, or the anonymous corpus of *Supplementary Problems*), where it probably constituted a conscious choice on the part of their authors.

medical enquiries, as well as providing mnemonic threads for navigating the medical books' contents.

Thirdly, revisiting enquiries, either within the same book or across different books, encourages alternative perspectives on the same problems.²³ When we are in the context of the same medical book, replications of material are concentrated towards the end: this suggests that scientists likely read back to the beginning, in order to select problems suitable for fresh investigation. Problems 33.1, 33.5 and 33.17 provide a characteristic example: 33.1 asks why sneezing stops hiccupping, but not belching. After clarifying that belching is an affliction of the stomach (and therefore unaffected by sneezing), while hiccupping of the lung (which is connected to the nose and brain through the process of respiration), the problem goes on to explain that the hiccup is caused by a lack of concoction: sneezing however, just like vinegar and holding one's breath, causes both the nose and lung to heat up, thus helping to achieve concoction, and thus to stop the hiccupping.²⁴ Problem 33.5 asks why sneezing and vinegar stop hiccups, essentially making use of the same explanation as 33.1, but with improvement in clarity (especially on the movements of breath and moisture within the body). Lastly, 33.17 re-focusses the question (it asks simply, why sneezing stops hiccups), picking up elements from the solutions of both the previous problems for its own answer. Even though each problem formulates its question in different terms, the explanations of all three present considerable overlap, each one adding a slightly different perspective on the enquiry at hand. In the case of enquiries that are replicated across different books, the change of context allows for an evaluation of the problem from a different perspective: thus, the enquiry of 1.48 (why fragrant seeds and plants are diuretic) is replicated almost verbatim in 12.12 and 20.16, both of which add some more information. In 1.48, the enquiry is found in the context of problems that discuss the effects of various drugs on the body. In 12.12, it is found in the context of enquiries that discuss the properties of other fragrant things (plants and substances, such as wine). In 20.16, finally, it has been inserted within a book that discusses shrubs and vegetables. This replication not only invites reflection on different possible classifications of fragrant seeds and plants (as drugs, as a special category of fragrant substances, or as (edible or inedible) plants), it also allows us to comprehend the terms in which the

²³ Cf. discussion in Flashar (1962, 323–25).

²⁴ The meaning is not very clear: the author seems to argue both that sneezing causes concoction of breath and moisture (961b12–13), and that it causes the enclosed air that causes the hiccup to break up (ῥήγνυσι) (b26–27): presumably the release of that confined air enables its concoction.

Problemata's medical and naturalist books are inter-complementary: doctors who seek to heal their patients and naturalists interested in classifying plants or explaining their different properties alike ask essentially the same questions about fragrant seeds and plants.

Cross-references, association, and the presence of parallel problems within the same book, or across books, ensure that the reader of the *Problemata's* medical sections draws connections between often distant problems; anticipates parallel treatments of certain topics later on, or in different contexts; makes note of the fact that certain theories or concepts may be applicable to different kinds of enquiries; and, last but not least, is able to evaluate the parallel solutions in terms of their cogency. These responses, which rely on a process of reading the *Problemata's* medical books sequentially, or re-reading them, are essential to the critical comprehension of the collection's medical subject-matter, as well as to the broader understanding of medicine as a component of naturalist investigation.

3 Questions and Answers in the Medical Sections: Format and Causation

The medical books of *Problemata* treat, as the terms themselves suggest, problems of medical content. How should one go about with the investigation of medical subject-matter, however? Neither Aristotle nor his successors bequeathed to us a theory of posing and solving problems that is tailored to medical problems in specific. We only possess his well-known definition of the dialectical problem in the *Topics* (1.1.104b1–18), his discussions of scientific problems and guidelines for solving them demonstratively in the *Posterior Analytics* (2.1.89b23–35), as well as actual examples of naturalist problems that he poses and solves in his works (especially his zoological writings).²⁵ These, together with examples in other medical and Peripatetic literature (including the *Anonymus Londinensis*, Theophrastus' *On Sweat* and *On Fatigue*, or pseudo-Aristotle's *On the Flooding of the Nile*)²⁶ are nevertheless useful for understanding the wider context of the medical books' method of posing and solving problems.

In the overwhelming majority of cases, the *Problemata* investigates medical topics by means of issuing problems introduced with διὰ τί . . . ; ("why . . .?"),

²⁵ On these, see Lennox (2001a).

²⁶ Aubert (2014, 646 F1). I would like to thank Stephen Menn for bringing this very interesting text to my attention.

which enquire after the causes of various physiological phenomena or conditions. A handful of enquiries, most of them concentrated in the second part of the first book, are introduced by πότερον... ἢ (οὐ)...; (“is it the case that... or (not)...?”) The same part also offers the greatest diversity of question-formats, including questions introduced by τίς... (ἡ ἀρετή); (“what is the virtue of...?”) (1.30, 1.33), or τῷ δῆλον...; (“by what is it clear...?”) (1.31). It also yields examples of enquiries concerned with quality, introduced by ποῖα δεῖ... (ἡ)...; (“which [wounds must one cauterise]... or [which must one cut]...?”) (1.32, with the question expanded in 1.34; cf. 17.3, πῶς...;), as well as a few cases of problems that lack a question-format altogether: these are 1.55–56, which are articulated as δεῖ-injunctions (“one should...”), and 1.57, making a general observation that “some diseases come from fire, whereas others come from dampness” (εἰσὶ δὲ).

The issuing of enquiries in interrogative format was not unfamiliar to the ancient medical tradition, as attested by several examples within the Hippocratic corpus. The ἥρα/ἄρα-enquiries of the *Epidemics*, *Prorrheticon*, and *Coan Prenotions* are the most characteristic in this respect: as a rule, they are issued with an exploratory aim, in order to prompt the further investigation of facts, or the meaning of certain symptoms (hence the fact that they are rhetorical questions, which receive no answers).²⁷ But not infrequently, they also seek to enquire after the causes of certain conditions: “he did not shiver on the seventh day (οὐκ ἐρρίγωσεν ἐβδόμῃ). Is it perhaps because his belly was disturbed? (ἥρα ὅτι ἡ γαστήρ προεταράχθη);” (*Epidemics* 4.25 = Littré 5, 168).²⁸ Causal enquiries formulated with διὰ τί also occur, suggesting a particular concern with reaching an accurate understanding of the factors that affect the human body, or can generate disease and other conditions:²⁹ “we must consider these things” (sc. the different directions of various pains and ailments), suggests the sixth section of the *Epidemics*, “in what way (ὅπῃ), from where (ὅθεν), and for what reason (διὰ τί)” (6 = Littré 5, 280).³⁰ Texts such as *Regimen in Acute Diseases* even posit that it is essential for medicine’s very credentials as

27 *Epid.* 5: Littré 5, 172, 352; 6: Littré 5, 278 (πότερον ἥρα). *Prorrh.* 1: Littré 5, 510, 514, 516, 534, 550, 552, 554, 558, 562, 564, 566, 568. *Coac.*: Littré 5, 600, 602, 606, 620, 622, 624, 626, 628, 634, 636, 638.

28 See also *Epid.* 6: Littré 5, 288, 296; 7: Littré 5, *Prorrh.* 1: Littré 5, 522, 548, 550, 552, 560, 568, 570. *Coac.*: Littré 5, 642.

29 See, in this respect, esp. VM 20 = Littré 1, 620–624 = Jouanna 145.17–148.2, with Schiefsky (2005) ad loc. See also Vegetti (1999), Jouanna (2005), and Barton (2005).

30 Cf. *Epid.* 7 = Littré 5, 282.

an art to probe into issues such as the reasons why doctors prescribe different regimens for acute diseases:

For instance, it has not been ascertained (ἀκαταμάθητα οὖν καὶ τὰδ' ἐστίν,) why (διὰ τί) in acute diseases some physicians think that the correct treatment is to give unstrained barley-gruel (πτισάνας ἀδιηθήτους) throughout the illness; while others consider it to be of first-rate importance for the patient to swallow no particle of barley, holding that to do so is very harmful, but strain the juice through a cloth before they give it. Others again will give neither thick gruel nor yet juice, some not before the seventh day, others at no time until the disease reaches a crisis. Now certainly physicians are not at all in the habit of even raising such questions (μάλα μὲν οὖν οὐδὲ προβάλλεσθαι τὰ τοιαῦτα ζητήματα εἰθισμένοι εἰσὶν οἱ ἰητροί); even when they are raised perhaps nothing is learned (ἴσως δὲ οὐδὲ προβαλλόμενα γινώσκεται). Yet the art as a whole has a very bad name among laymen, so that there is thought to be no art of medicine at all. (*Acut.* 7–8 = Littré 2, 238–240; Jones trans.)³¹

We may compare this with problem 2.21, which enquires after whether it is better to induce sweating in the summer, rather than in winter (πότερον δεῖ μᾶλλον τοῦ θέρους παρασκευάζειν τὸ ἰδρὸν ἢ τοῦ χειμῶνος; 868a25–34). The formulation πότερον . . . ἢ . . ., is familiar from Aristotle's definition of the dialectical problem in the *Topics* (104b1–18).³² The first answer makes a case for winter being the most appropriate time, as bodies are moister then, the change (μεταβολή, presumably in climate and weather conditions) is greater, and the residues are not as easily concocted (τὰ περιττώματα οὐ συνεκπέττεται) (868a26–30). The second answer begins with an objection to the first one: “then again (πάλιν . . . ἔτι), sweating in winter, when the body is cooled, is against nature (παρὰ φύσιν)” (868a30–31). The conclusion therefore follows (δῆλον ἔρα ὅτι) that the summer is a better time, which is further justified through the argument that this is when moisture putrefies (therefore one needs to remove it by means of sweating), and by adducing in support the agreement of “all the ancients” (οἱ ἀρχαῖοι πάντες) on the matter (868a30–34).³³ The problem, finally, includes the presence of a doxographical element (what “all the ancients claim,” on the whole

31 Cf. *VM* 20 = Littré 1, 622; *Flat.*: Littré 6, 98. *Morb.*: Littré 7, 542.

32 See also *Pr.* 1.37, 50b; 2.12, 2.33; 9.6. Cf. 12.10.

33 The “ancients” probably does not include Theophrastus: Flashar (1962, 429) had surmised a dependence of *Pr.* 2.21 on *Sud.* 23, but the connection is (correctly) rejected by Fortenbaugh (2003, 104), who does not see any close parallels in content. Hippocratic

extremely rare in the *Problemata's* medical sections):³⁴ we are reminded of the guidelines issued by Aristotle in his *Topics* 1.14, on how to excerpt and classify statements and opinions from individuals on specific issues, in order to use them in dialectical debate.³⁵

Yet despite its format our problem is primarily concerned with causes (why a certain therapeutic procedure is better than another, the reasons attributed to the conditions of the environment, and how they affect the human body). We may compare this with two subsequent problems that treat the same subject in the same book, 2.33 and 2.42: problem 2.33 issues the exact same *πότερον... ἢ...;* question as 2.21, but puts its weight on developing only one side of the answer, namely, that it makes more sense to induce sweat in the summer (869b32–70a5); 2.42, in turn, converts the question into a why?-type enquiry into the particular reasons why one should not want to induce sweats in winter (thus taking it for granted that they are more beneficial in the summer). It seems that the “orthodox” answer to the question, so to speak, was to argue that it made more sense to induce sweats in the summer, rather than in winter. The different reasons each problem adduces in support of this view suggest the debate revolved around the issue of which physiological factors to pinpoint as central to the explanation. In this way, they put into relief the process of critical judgement that underpins the choice of therapeutic praxis, and, more broadly, point to the relevance of scientific speculation to practical matters of regimen and treatment.³⁶

The *Problemata's* medical books are overwhelmingly orientated towards the investigation of what causes various bodily states and physiological conditions: their why?-type enquiries seek to problematise the links between illness and environment; probe into the underlying physical mechanism of health, disease, or other key physiological phenomena, such as sweat, sex, drunkenness (in terms of the interactions between physical elements, and the role of different physical processes within the body);³⁷ and enquire after why (in terms of what powers, or qualities) certain substances such as drugs, or antidotes, are

authors, and Diocles of Carystus, may be implied, among others, though, again, there are no close parallels (cf. Diocles fr. 30a–d van der Eijk).

34 See also 3.16. The near-total absence of doxography is what distinguishes the *Problemata's* medical books from Peripatetic problem-texts such as the *On the Flooding of the Nile*.

35 See Brunschwig (1967) and Smith (1997) ad loc, and Mansfeld (1992).

36 Cf. Aristotle's mention, in *Topics* 1.10 (104a33–38), of dialectical propositions of medical subject-matter, part of a wider category of dialectical propositions which accord with the arts (*ᾧσαι... κατὰ τέχνης εἰσὶ*).

37 Cf. Anon. *Londin.* XXXI.53–XXXII.2, XXXIII.8–9 Manetti.

efficacious. By contrast, the factual basis of these states (whether they hold or not, and what they are in terms of their essence, or substance) is not usually at issue, nor are operations such as the classification of diseases or symptoms.³⁸ The opening question of the first book allows us to comprehend what is at stake. The question that is asked is why certain excesses (sc. of certain elements in the environment) are disease-producing. They produce either excess or defect (sc. within the body), the answer suggests, which *are* in fact disease (859a1–2).³⁹ The problem embeds the definition of disease as excess or defect (sc. of certain elements within the body) to its explanation, according to the following schema:

Great excesses (A) produce either excess or defect (B)
 Excess and defect (B) are disease (C)
 Great excesses (A) produce disease (C)

Excess and defect are the “middle term” that explains why great excesses cause disease (according to Aristotle’s method of scientific demonstration⁴⁰). Finding the middle term, as Aristotle explains in the *Posterior Analytics* (2.14.98a1–23), is predicated on a specific methodology that involves the division of the subject under question according to its genus and species, and the listing of the attributes that universally apply to each individual class. Once one has carefully mapped out their subject in this way, they can proceed to the solution of their problem demonstratively, by showing that something holds of a given class, or category, because it holds of a class or category that stands above it in the hierarchy as well. There is no doubt that this methodology is relevant to the solution of the causal enquiries issued by the *Problemata*’s medical sections (although more systematic study is required).

Problems such as the above, which offer a single answer, comprise the greatest majority within the *Problemata*’s medical books (about eighty percent of all problems).⁴¹ We also encounter problems which propose multiple solutions

38 Cf. other medical works in question-and-answer form, such as Caelius Aurelianus’ *Medicinales Responsiones*, as well as medical papyri written in this format, which do provide such lists.

39 Emphasis following Mayhew (2011) ad loc.

40 As Barnes puts it, “for any facts p^1 and p^2 , if p^1 explains p^2 then there is a demonstrative syllogism $AaB, BaC \vdash AaC$ such that AaC expresses p^2 and the middle term expresses p^1 ” (2002, 205). Cf. also *APo.* 2.8.93a29–b13. See also Hankinson (1998, 125–88).

41 91 out of 483 problems in the medical books offer two or more solutions. This is roughly the same ratio as for the remainder (non-medical) books, where 71 out of 401 problems propose more than one solution.

(between two and five), thus opening a larger field of possibilities. Usually no statement of preference between them is given, the final judgement left to the reader. In cases such as problem 4.31, however, the intellectual reasoning that is followed acts as an indication of how criteria of judgement should be applied:

Why are birds and hairy humans lustful? Is it because (πότερον ὅτι) they contain much moisture? Or is this not so (for the female is moist, but not hairy), but it is because (ἢ οὐ . . . ἀλλ' ὅτι . . .) both natures concoct a lot of moisture owing to heat? A sign of this is the hair and the feathers. Or is it because (ἢ ὅτι) there is a lot of moisture, and it is mastered by the heat? For if there were not a lot of moisture or if it were not mastered, then hair would not grow on the one or feathers on the other. Now the seed comes to be plentiful in such places and seasons, for example in the spring; for its nature is moist and hot. And for the same reason, both birds and the lame are lustful; for in both, the nourishment below is meager owing to the deficiency of their legs, but (more nourishment) goes to the upper region and is condensed into seed (880a34–b8, Mayhew trans.)

In this example, the second possibility relies upon the rejection of the first one (on the basis of the female constituting an exception to the rule that moisture necessitates hairiness, and hence lust), while the third possibility is a synthesis between the previous two (both the moisture and the concocted heat boost the production of seed, as they also cause feathers and hair to grow). The right solution is then to be identified with the most adequate explanation, in the sense of the explanation that takes the full spectrum of contributing factors into account (abundance of moisture, together with its mastery by the heat).⁴²

What is most distinctive to the medical books' answers is their emphasis on material causes—that is, causes located in the properties, movements, functions, and interaction of material substances.⁴³ Teleological explanations are nearly non-existent:⁴⁴ the problems frequently state that certain physiological conditions or diseases ensue from various processes within the body *out of necessity*, as in the following passage from problem 2.41 (on why sweats that

42 Cf. e.g. 3.26, 5.13, 5.37, 8.17, 9.3 (contrast with problems such as 2.4, 2.9, 3.31).

43 Marengi (1965, xvi–xvii), Mayhew (2011): xxii–xxiii.

44 Only in 4.15 (878b2 ff.), where we find the conjunction ἐξ ἀνάγκης . . . ἕνεκά τινος. But see also Stoyles in this volume, focussing on the explanations of book 10. On the priority of teleological versus other types of explanation in Aristotle's philosophy of nature, see Kullmann (1974): 269–341; Hankinson (2001): 132–58; Lennox (2001b): 124–26.

occur within the body automatically are considered worse than those that ensue from exertion):

But the sweats that are named automatic, and that occur by necessity (ἐξ ἀνάγκης) when the heat is not completely captured because the natural passages are disturbed by large amounts of moisture, but still can resist and secrete it, are reasonably regarded as a sign of disease (εὐλόγως νόσου σημεία φαίνεται) (870b20–25, Mayhew trans.).⁴⁵

We may recall Aristotle's statement in the opening of the fifth book of the *Generation of Animals* that, for certain types of conditions (παθήματα) that occur to animals (such as colour of eyes, pitch of voice, or colour of hair), we lack the ability to provide the final cause, and must, instead, remain content with explaining the change as stemming out of necessity (meaning due to changes in material substance involved) (778a16–b19). It seems that the medical books on the whole treat diseases, pathological phenomena, and physiological states such as sweating as conditions of analogous type—that is, as alterations to the body's state that can only be attributed to necessity (by which the physiological impact of changes to the movement, distribution, quantity or quality of bodily substances such as heat and moisture is meant, as in the passage above).

4 Conclusions

The medical books of the pseudo-Aristotelian *Problemata* hold for many reasons the key to the collection as a whole. This is because they not only provide vital clues as to the broad scientific interests of the Peripatetic scientists who contributed to the *Problemata*, they also invite productive speculation on their conception of the relationship between different scientific fields, the order in which they ought to be studied, and the procedure one should follow in order to investigate them via the technique of posing and solving problems. The structural and methodological features of the *Problemata*'s medical books that I have here drawn attention to allow us to gauge the scientific mindset and authorial objectives that drove their composition, and, for this reason, they can also afford fruitful starting-points for a more systematic understanding of how this vast agglomerative work came to acquire its present shape and form.

45 See also 860b20–21, 862b4, 877a14–16, 881b13–18, 892b12–13, 894b10–11.

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Creating *Problemata* with the Hippocratic Corpus

Oliver Thomas*

This chapter discusses how the Aristotelian *Problemata* engage with the Hippocratic corpus. The existence of such engagement was the subject of a fundamental study by Poschenrieder (1887, 38–66); more recently Bertier (1989), Jouanna (1996), and Ulacco (2011, 67–77) have discussed particular examples; Flashar’s commentary (1975, esp. 338–40) and the notes to the editions of Louis and Mayhew contain numerous references.¹ My aim is not primarily to revisit arguments about whether a particular parallel implies source-use, nor to uncover new parallels. Instead I shall focus on what the parallels tell us about how the Hippocratic corpus was read and used by Aristotle and his followers. This provides evidence of both the early reception of the Hippocratic corpus, and the role of medical authority among Peripatetics. One productive approach (touched on for example by Jouanna and Ulacco) is to situate the *Problemata*’s explanations, where their *content* contrasts with Hippocratic ones, in the context of Peripatetic physiology. But here I shall focus, more basically, on the range of *forms* of engagement, from the straightforward conversion of proposition-plus-explanation into a *problema*, through cases of supplying, altering and combining explanations, more or less complex processes of extracting a proposition, and instances of reapplying some Hippocratic data to a different problem. My contention is that by delineating these various processes, and by contrasting them where possible with Galen’s commentaries on the same Hippocratic passages, we can better understand the enduring pedagogical value of *problemata* as a format for study.

* My thanks to the audience in Oxford who gave very helpful comments on an early version of some of the material presented here. All translations are my own.

1 Where I cite Flashar (1975), Louis (1991–1994), and Mayhew (2011) by name alone, understand “ad loc.”

1 **Reformatting and Probing Hippocrates**

Hippocrates is not cited by name in the *Problemata*, unlike various natural philosophers.² (The nearest one gets is a reference at 30.1.953a16 to ‘sacred disease’ being the terminology of οἱ ἀρχαῖοι for epilepsy, as in the Hippocratic *Morb.Sacr.*)³ However, Theophrastus is nowhere cited by name either, despite the fact that the *Problemata* (particularly in books 2, 5, 12–13, 20, 23–26, and 30.1) convert extensive passages of claim-plus-explanation from his works into the *problema*-format.⁴

No *problema* in the extant collection paraphrases Hippocratic material quite like this.⁵ However, if we look to the earlier edition of “Aristotle’s *Problemata*” read by Aulus Gellius, we do find an example.⁶ Gellius (19.5) cites the question in Greek, then gives the explanation in Latin with a Greek précis. Both parts are remarkably similar to *Airs Waters Places* 8, as the comparison in Table 1 shows.

TABLE 1 *Comparison of Gell. 19.5 and Aër. 8.8–10. Numbers in brackets refer to key ideas*

Gellius (Latin)	Gellius (Greek paraphrase)	<i>Airs Waters Places</i>
[Question given only in Greek.]	(1) διὰ τί τὰ ἀπὸ χιόνος καὶ κρυστάλλων ὕδατα φαῦλά	(1) Τὰ δὲ ἀπὸ χιόνος καὶ κρυστάλλων [sc. ὕδατα] πονηρὰ πάντα· (2) ὁκόταν
(2) <i>quoniam cum aqua frigore aeris duratur et coit,</i>	ἐστιν; (2) ὅτι παντὸς ὕδατος πηγνυμένου (3) τὸ λεπτότατον	γὰρ ἀπαξ παγῇ, (3) οὐκ ἔτι ἐς τὴν ἀρχαίην φύσιν καθίσταται, ἀλλὰ τὸ
(3) <i>necessum est fieri euaporationem et quandam quasi auram tenuissimam exprimi ex ea et emanare.</i>	καὶ κουφότατον ἐξατμίζει. (6) σημεῖον δέ, ὅτι ἔλαττον γίνεται ἢ πρότερον, ὅταν τακῇ παγέν. (4) ἀπεληλυθότος	μὲν αὐτέου λαμπρὸν καὶ κοῦφον καὶ γλυκὺ ἐκκρίνεται καὶ ἀφανίζεται, (4) τὸ δὲ θολωδέστατον καὶ σταθμωδέστατον

2 See Mayhew’s index (2011, 2: 433–34) s.v. Alcmaeon, Anaxagoras, Empedocles (see also Arist. fr. 718 Gigon), Heracliteans, Plato, Pythagoreans; also the mathematician Archytas.

3 Cf. the claim of οἱ ἀρχαῖοι πάντες cited at 2.21.868a33, that sweating-treatments should be applied in summer rather than winter. I am not aware of this being Hippocratic. ἀρχαῖοι cosmologists are cited at 25.21.939b34.

4 See e.g. Flashar (1975, 335–38), Richter (1885, 5–30).

5 We will return below (n. 37) to 2.35, which appears to rewrite a passage of observation and explanation from *De morbis* in more Aristotelian terms.

6 Gell. 19.5 = Arist. fr. 760 (fr. 711–69 give the testimonia to ancient collections of Aristotelian *Problemata*). Gellius mentions (19.6) that he read the *Problemata* with L. Calvenus Taurus, his teacher in Athens in c.146 (see Holford-Strevens 2003, 90–97).

Gellius (Latin)	Gellius (Greek paraphrase)	<i>Airs Waters Places</i>
(4) <i>'id autem' inquit 'in ea leuissimum est, quod euaporatur'; manet autem, quod est grauius et sordidius et insalubrius, (5) atque id pulsu aeris uerberatum in modum coloremque spumae candidae oritur. (6) sed aliquantum, quod est salubrius, difflari atque euaporari ex niue indicium illud est, quod minor fit illo quod ante fuerat quam concresceret.</i>	οὖν τοῦ ὑγεινοτάτου ἀνάγκη αἰεὶ τὸ καταλειπόμενον χεῖρον εἶναι.	λείπεται. (6) Γνοίης δ' ἂν ᾧδε· εἰ γὰρ βούλει, ὅταν ᾗ χειμῶν, ἐς ἀγγεῖον μέτρῳ ἐγχέας ὕδωρ, θεῖναι ἐς τὴν αἰθρίην, ἵνα πῆξεται μάλιστα, ἔπειτα τῇ ὑστεραίῃ ἐσνεγκῶν ἐς ἀλέην, ὅκου χαλάσει μάλιστα ὁ παγετός, ὁκόταν δὲ λυθῇ, ἀναμετρήσειν τὸ ὕδωρ, εὐρήσεις ἔλασσον συγχῶ. (3) Τοῦτο τεκμήριον, ὅτι ὑπὸ τῆς πῆξις ἀφανίζεται καὶ ἀναξηραίνεται τὸ <u>κουφότατον καὶ λεπτότατον</u> , (4) οὐ τὸ βαρύτατον καὶ παχύτατον· οὐ γὰρ ἂν δύναίτο.
[Question given only in Greek.] (2) Because when water hardens and coalesces through the coldness of the air, (3) there is necessarily evaporation and a kind of very thin exhalation is squeezed out and emanates from it. (4) 'It is,' he says, 'the lightest part of it which evaporates.' The heavier, dirtier and less healthy part remains. (5) It is whipped by the air and takes on the nature and colour of white foam. (6) Evidence that some portion—the healthier part—is exhaled and evaporated from snow is that it becomes smaller than it was before solidifying.	(1) Why are waters deriving from snow and ice bad? (2) Because when any water hardens the lightest and most mobile part evaporates. (6) Evidence is that it becomes smaller than before whenever it thaws after freezing. (4) Hence, when the healthiest part is gone, necessarily and in every case the remainder is worse.	(1) Waters deriving from snow and ice are all poor. (2) For as soon as they ever harden, (3) they no longer take on their old nature. Rather, its bright and mobile and sweet part is separated out and disappears, (4) whereas the most turbid and sedimentary part remains. (6) You can see this as follows: if you like, whenever it is winter, pour water using a measure into a pail, put it in the open so that it will be sure to harden, then on the following day bring it to a warm spot where the ice will be sure to dissolve. When it has done so, measure the water, and you will find it significantly less. (3) This is a sign that the lightest and most mobile part disappears and is dried up by the freezing process— (4) not the heaviest and thickest part, which would be unable to.

Evidently the ideas are presented in different orders, and Gellius' Latin includes point (5) about the frothy colour of snow and ice.⁷ But still one can speak of a paraphrase of *explanandum*, explanation and evidence, complete with some verbal similarities where Gellius offers us the Greek.

We shall see that *Airs Waters Places* was of particular interest to the *problema*-writers, though elsewhere as something which required more probing.⁸ After all, in the surviving fragment (112) of Aristotle's essay *On Problemata*, Alexander specifies that for Aristotle natural *problemata* were "things pertaining to nature whose causes are unknown" (ὧν γὰρ φυσικῶν ὄντων τὰ αἰτία ἀγνοεῖται, ταῦτα φυσικὰ προβλήματα). Indeed, in the majority of passages I shall be looking at, the *problema* explains a Hippocratic assertion without simple recourse to a Hippocratic explanation from the same source.⁹ This explanatory aim accords with various implications of the early philosophical uses of πρόβλημα. In Plato's *Theaetetus* (180c–d), Socrates and Theodoros characterise what they call "Ionian" natural philosophy as being practised through obfuscation, and hence set about examining it "like a *problema*." Socrates expresses its position in terms of two propositions: that Okeanos and Tethys are parents of all (*Iliad* 14.201), and that everything is in motion (Heraclitus 22A6 DK). Each *problema* encapsulates a prior author's key position so as to make it amenable to debate. Aristotle's definition of dialectical *problemata* in *Topics* 1 (1.4.101b16–36, 1.11.104b1–105a9) includes a particular sub-category, *theseis*, which are based on a disputable opinion of an authoritative thinker (104b29–35).¹⁰ Meanwhile, Aristotle's category of the poetic *problema* (*Poet.* 25.1460b6–1461b12) is also structured around authority: a question like "Why does Telemachus not meet his grandfather Ikarios when he visits Sparta?" is a cue to criticise or defend Homer's coherence. Hence authority was ingrained in the construction of *problemata* in various contexts, and it is unsurprising that several of the surviving medical *problemata* should probe the authority of Hippocrates. What will concern us as we proceed is how explicitly they do so.

7 This perhaps derives from *GA* 2.2.735b19–21, on how air whitens froth and snow.

8 On the reception of *Aër*. see Diller (1932).

9 See Quarantotto (2011, esp. 32–34), on how the *Problemata* fit into an Aristotelian "research programme" of establishing propositions then probing their causes.

10 For Aristotle's sense(s) of *problema*, see Lennox (1994), Slomkowski (1997, 14–19), and Mansfeld (1992) for the importance placed on tackling dialectical *problemata* through the opinions of (multiple) previous authorities. For the earlier history of *problemata* see e.g. Flashar (1975, 297–303).

2 Ways of Explicating Hippocrates

I shall order my discussion not by the Hippocratic source-text (for this, I append Table 3), but mainly by the form of engagement with it. In fact, several of these forms can be introduced by examining the longest and best-known case where the *Problemata* offer “commentary” on a Hippocratic text—the relationship between *Pr.* 1.8–12, 19–20 and chapter 10 of *Airs Waters Places*.¹¹ This chapter discusses five bad weather-patterns and the illnesses they produce, with varying complexity in providing aetiologies and further details, as outlined in Table 2. The patterns are excerpted in much reduced form as *Aphorisms* 3.11–14, while the seven *problemata* mentioned discuss them in more detail.¹²

TABLE 2 Comparison of the contents of *Aër.* 10.3–12, *Aph.* 3.11–14, and *Pr.* 1.8–12, 19–20

<i>Aër.</i> 10.3–12	<i>Aph.</i> 3	<i>Pr.</i> 1
3. Pattern 1: dry winter dominated by northerlies + opposite spring: —effects in summer: fevers, eye-disease and dysentery —aetiology: moisture in soil and guts suddenly heated; fevers for the phlegmatic, dysentery for the moist	11 11 –	8, 19 8 8, with alterations
4. —further detail: hope if Sirius brings rainstorms	–	19, with explanation
5. Pattern 2: wet winter dominated by southerlies + opposite spring: —effects on spring pregnancies: miscarried or weak babies	12 12	9 9, with explanation

11 Ulacco (2011, 72–76) and Jouanna (1996) discuss characteristically Peripatetic vocabulary in these *problemata*; Poschenrieder (1887, 43–52) is still useful.

12 That *Aphorisms* is using *Airs Waters Places* here is implied by the compilatory nature of *Aph.* 3 as a whole, and the fact that phrases which are not contiguous in *Aër.* 10 get joined in *Aph.* 3.11–14 but not vice versa. *Pr.* 1.8, 9, 12, 19, 20 share material with *Airs Waters Places* which *Aphorisms* has omitted.

TABLE 2 *Comparison of the Contents of Aër. 10.3–12, Aph. 3.11–14, and Pr. 1.8–12, 19–20. (cont.)*

<i>Aër.</i> 10.3–12	<i>Aph.</i> 3	<i>Pr.</i> 1
6. —effects on others in summer, with aetiology: dysentery for phlegmatic and women, dry eye-disease for bilious, catarrhs for elderly; 7. further aetiology: brain congealed through spring and suddenly dissolves	12 (effects only)	9, with reordering
8. —further details: which towns most effected; 9. what if summer is dry or rainy?	—	—
10. Pattern 3 : summer and autumn both wet and dominated by southerlies:	—	20
—effects: kausoi for phlegmatic and those over forty; pleurisy for bilious	—	20, with explanation
11. Pattern 4a : dry summer dominated by northerlies + opposite autumn:	13	10
—effects in winter: headaches, colds etc; some consumption	13	10, with explanation
12. Pattern 4b : dry summer dominated by northerlies + same autumn:	14	11–12
—effects on phlegmatic and the moist: good	14	11
—effects on bilious and aetiology: bad for bilious since they dry out; causes dry eye-disease, fevers, melancholy since the bile and blood are thickened	14 (effects only)	12
—aetiology for phlegmatic: good since they dry out	—	11

This cursory overview indicates that, whereas the *Aphorisms* systematically remove aetiological elements, the *Problemata* supply an explanation where *Airs Waters Places* lacks one, and also modify its explanation of the first pattern. A more instructive and fine-grained contrast is between the type of “commentary” offered by the *Problemata* and by Galen’s commentary on the relevant parts of *Aph.* 3, which he explicitly elucidates using *Aër.* 10 with the stated purpose of “clarifying what is unclear...and adding proof to every

true statement.”¹³ Galen immediately goes on to contrast his approach with his near-contemporary Lykos, who added no interpretative argumentation for these particular aphorisms and left them as merely empirical assertions. Galen’s Hippocratic commentaries frequently attempt to recover traces of his system in the Hippocratic works, to increase his authority.¹⁴ This puts some constraint on how he can use the explanatory passages from *Airs Waters Places*. By contrast, both the attitude to authority in the *Problemata* and their format allow for a freer exploration of the material.

For example the *Problemata* leave 1.8 and 1.19 containing an incompatibility. Both deal with the pattern of a cool dry winter followed by a warm wet spring, but 1.8 neglects the final (unexplained) detail of the Hippocratic passage, namely the consequences if the summer stays dry beyond the rising of Sirius. According to its explanatory model, a damp summer is more dangerous than a dry one, because it leaves the body full of fluids which can putrefy (860a8–11). But the final Hippocratic detail states that a damp summer is *less* dangerous, and *Pr.* 1.19 finds an alternative model which accords with this: the body’s fluids can prevent it from overheating. Galen might say that 1.19 therefore provides the better explanation of *Aër.* 10. But when viewed from the perspective of a student studying the *Problemata* without *Airs Waters Places* to hand, such discrepancies among potential solutions were a stimulus to intellectual engagement. This emerges, in fact, from Plutarch’s and Gellius’ crucial testimonia about how editions of the *Problemata* could be used by educated readers. For example, in Aristotle fr. 735 (= Plutarch *Quaest.conv.* 8.10) a copy of the *Problemata* fills Florus with many uncertainties, which he shares with his companions (αὐτός τε πολλῶν ἀποριῶν... ὑπεπίμπλατο καὶ τοῖς ἐταίροις μετεδίδου); one is the *problema* “Why are dreams least reliable in autumn?”, for which Favorinus and Autoboulos come up with playful competing explanations to add to the Aristotelian one.

Returning to the engagement with *Aër.* 10, a second significant example is how 1.9 intelligently reads across the grain of its source. *Airs Waters Places* presents the weather-pattern and first describes its effects on spring pregnancies, then its effects on others. A first level of explanation relates the latter

13 17b.561 Kühn (from the preface to *Hipp. Aph.* 3), and 577–99 for the commentary. Galen subsequently wrote a commentary on *Aër.* itself, which only survives in translation. The Arabic is to be edited by Strohmaier; its importance is discussed in Jouanna (1991), Strohmaier (2004). The Hebrew précis (Wasserstein 1982) breaks off at *Aër.* 10.4.

14 See Flemming (2008, esp. 330, 334), Lloyd (1991, 398–416), and in general Manetti and Roselli (1994).

effects to humours (10.6 τοῖσι μὲν οὖν φλεγματῆισι... τὰ δεξιὰ), before a second level relates them to the temperature and moistness of the body as it develops through summer (10.7 ὁκόταν γάρ... νοσεύματα ἐπιπίπτειν). Both *Pr.* 1.9 and Galen notice that, unlike the other effects, the troublesome pregnancies (a) occur in spring, and (b) are not explained. Galen follows the contorted order of exposition of *Airs Waters Places* (unnecessarily: recall that his lemma is *Aph.* 3.12), whereas the *problema* disentangles it. The question becomes why, in *this* weather-pattern, both spring and summer are unhealthy. The answer traces the fundamental reasoning about fluidity and temperature through winter to spring, where it supplies an explanation for the effects on pregnancies, and thence to summer and its diseases. These too are reordered by severity, from dry eye-disease up to apoplexy. A consequence of this is that, unlike in *Airs Waters Places*, catarrhs in the phlegmatic are not treated apart from catarrhs in the elderly.¹⁵ Similar disentanglement occurs in *Pr.* 1.11–12, which split the processes and effects of the final weather-pattern into separate, slightly expanded discussions about its effects on the phlegmatic and the bilious.¹⁶

This cluster of *problemata* engage with an extended passage of *Airs Waters Places* very closely; while there are places where they rewrite passages of Hippocratic explanation, none is pure paraphrase. They are not afraid to suggest new or modified explanations, and when compared to Galen they show that freedom from his more restrictive form—a lemmatic commentary with vested interests in the source's correctness—could be pedagogically useful, both in disentangling the source and in promoting debates about it.

Adding and supplanting explanations are processes which can be seen on a smaller scale in various other *problemata*. Those where the *problema* takes a ready-made Hippocratic proposition include 1.50a (~ 4.16), which suggests an explanation for the assertion in *Epidemics* 6.5.15 that libido assists in phlegmatic diseases, using similar Greek phrasing.¹⁷ The nearby passage *Epid.* 6.5.1, a list of auto-regulating and unlearned bodily functions, perhaps inspired *Pr.* 34.12, which tries to explain the regulation of breathing and blinking, rather

15 Galen also treats the two types separately, but justifiably given his argument that 'catarrh' is being used in two slightly different senses (*Hipp. Aph.* 17b.589). Ulacco (2011, 74) discusses how *Pr.* 1.9 imports at the end an Aristotelian idea about the innate heat of the elderly.

16 Galen rejigs the order of *Aēr.* 10 in the same way in commenting on *Aph.* 3.14.

17 λαγνείη τῶν ἀπὸ φλέγματος νούσων ὠφέλιμον becomes διὰ τί συμφέρει πρὸς τὰ ἀπὸ φλέγματος νοσήματα λαγνεία. The topic of *Pr.* 1.50 changes abruptly at 865a35 πότερον. The textual evidence then favours no particle (the *lectio difficilior* of Y^a C^a; and in *PPA* 2.23 a new *problema* starts here). Once this *problema*-division went unmarked, the other manuscripts naturally added a particle to avoid asyndeton. At the start of *Pr.* 1.50b, it is not difficult to understand "a disease" as the object of ἀρχομένῳ.

than leaving them as wonders of nature as Hippocrates and even Galen in his fascinating commentary do.¹⁸

By contrast, *Pr.* 11.3 is an instance of attempting to elucidate an opaque explanation in *Epidemics* 6, namely from 6.4.19 “Those who contain the greatest warmth have the loudest voices, since the cold air is also greatest, and the products [ἔκγονα, lit. ‘children’] of two large things are large.”¹⁹ The last phrase seems to offer a partial explanation: the two large things which have been mentioned are the abundant warmth and the volume of air, but how do they generate the voice? The *problema* rewrites the question as “Why are all those with a hot nature loud-voiced?” and suggests that the large quantity of heat draws in a large quantity of cold air. Then, following Aristotle’s view (*GA* 5.7.787a2–22), the volume of sound is correlated to the volume of air expelled, while pitch is correlated to speed. This is not fully convincing as an explication of the Hippocratic metaphor, in that the two “parents” (the great warmth and the large quantity of air) are unequal: the former causes the latter. Again, we can contrast Galen’s struggles with the same passage (in *Hp. Epid.* 6.4.25) to show the *Problemata*’s different attitude to Hippocratic authority. Galen’s view, contradicting Aristotle’s, is that a loud voice is caused by lots of air made to move quickly by a strong throat, and he relates this to inner heat via sophisticated evidence from the dissection of animal hearts. However, his reverence forces him to take seriously the task of explicating Hippocrates’ view, and so to admit that it fell short of Galen’s own, since Hippocrates mentioned neither strength nor speed. The *problema*, however, picks out the interesting observation, does not preserve an attribution, and unapologetically suggests a possible Aristotelian direction for a reader to explore.²⁰

18 In the Hippocratic passage (cf. Manetti and Roselli (1982), *Gal. Hipp. Epid.* 6 [CMG V 10.2.2 p. 259.9]) I suggest οἷον τὸ σακαρδαμύσσειν καὶ <ῆ> ἢ γλώσσα ὑπουργεῖ, “such as blinking, and <how> the tongue does service.” As Bertier (1989, 266–68) observes, several other processes in the *Epidemics* passage are explored elsewhere in the *Problemata*, especially sweating in book 2 and sneezing in book 33. But it would be rash to suppose that all these *problemata* are a *systematic* attempt to explain a single Hippocratic passage.

19 Cf. *Sup.Pr.* 2.96, very similar in phrasing to *Pr.* 11.3. Bertier (1989, 262) comments that this is the only case of the *Problemata* trying to *clarify* an explanation from the *Epidemics*.

20 More dubious cases of supplanting explanation include *Arist. fr.* 736 and *Pr.* 6.3. If *fr.* 736 is indeed to be ascribed to an edition of *Problemata*, it may take the claim that a post-prandial walk is beneficial from *Hp. Vict.* 2.62, and slightly alter the explanation (... because it fans the food’s warmth, rather than because it warms the food). 6.3 discusses why it is best (and recommended by most doctors—a nod to source-texts) to lie slightly curled in bed. Commentators have compared this to *Hp. Prog.* 3, where it is a good sign for a *patient* to be lying like this, since it is a normal posture for healthy people, but also Diocles of Carystos

3 Ways of Mining Hippocrates

The Hippocratic texts did not always provide ready-made propositions for the *problema*-writers to tackle. In this section a range of relationships between the source and explanatory material will continue to be on display, but my focus will shift to the extraction of a question for the *problema*.

One basic procedure is to draw together non-contiguous clauses in the source, omitting other parts. A simple example is *Pr.* 11.38, “Why are stammerers melancholic?” This takes its cue from the assertion at *Epid.* 2.5.1 “The lisping or bald or stammering or hairy have strongly melancholic illnesses.” The *problema* deals with stammerers and—in the explanation—lispers, but omits the bald and hirsute. By ditching some phenomena, the *problema* may seem to expose itself to easily falsifiable explanations, but possibly the extra focus arose when our collection was rearranged, for “archival” convenience, by topic (in *Pr.* 11, the voice).

Several cases involve abridgement of a wider span of the source. *Pr.* 35.9 (“Why do we often shiver after food?”) perhaps arose as an encapsulation of the end of *De flatibus* 7, which traces a detailed causal chain from fullness to shivering. If so, the *problema*’s compendious treatment omitted a detailed physiological explanation from the source, and left us with the much feebler suggestion that (all!) food itself is cold. But abridgement need not entail simplification. *Pr.* 5.6 asks “Why is a massage with a mixture of water and oil better at stopping fatigue-pains?” (881a4–5 διὰ τί οἱ κόποιοι μᾶλλον παύονται ὅταν τις τῷ ἐλαίῳ ὕδωρ συμμίξας ἀνατρίψῃται;). It argues that the mixture sinks into the flesh better than oil alone, and thus can soften it (881a8 μαλάττεται) rather than drying it out. This seems to borrow from the comment at the end of *De victu* 2.65 that “a massage of oil with water softens” (τρίψις ἐλαίου σὺν ὕδατι μαλάσσει), combined with the gist of the lengthy chapter 66, that soreness can arise in various ways from the flesh drying out.²¹ Thirdly, the question of *Pr.* 14.1 is “Why are those who live in extremes of either cold or scorching heat [καύματος] more beast-like [θηριώδεις] in both their characters and looks?” This appears to arise by a compression of the start and end of *Aēr.* 24, namely 24.2 “All those [Europeans] who live in a mountainous, rough, elevated and watery country, where the changes of season bring great differences, are likely to be tall of appearance, and naturally disposed to hard work and bravery; and such natures have no

fr. 182.8 van der Eijk, which also recommends lying on one’s side slightly curled, and not just for the sick. The three texts give different rationales.

21 Poschenrieder (1887, 58). Flashar thinks that Diocles could be a more immediate source, but his phrasing (fr. 182.4) is not so close.

small portion of the wild and beast-like [θηριώδεις]” and 24.10, where those in a bare, rough country, “weighed down by winter and scorched [χεκαυμένη] by the sun” are described first in terms of their appearance (sinewy, hairy), then their character (“containing a greater share of the wild than the tame”). *Airs Waters Places* and *Pr.* 14.1 distinguish themselves from similar sources by discussing the climate’s influence on “beast-like” humans, using the adjective θηριώδης.²² The explanation supplied in the *problema*, that climate can distort both body and mind, appears to be its own. Even more broadly than that example, the general tenor of question and answer in *Pr.* 1.3 draws on the prefatory survey of factors of disease in *Airs Waters Places* 1, as well as on chapter 11 for details about changes of seasons and significant stars.²³

More complicated, both in the extraction of questions and the treatment of explanations, is the relationship of *Pr.* 21.2 and 21.8 to book 2 of the Hippocratic *De victu*. The latter discusses the digestive properties of barley and different types of barley-breads (ch. 40), barley-gruels (ch. 41), wheat, different types of wheat-breads and wheat-gruels (ch. 42).²⁴ Chapter 42 begins with the assertion that “Wheat-grains are more powerful and nourishing than barley-grains, but they and their liquid pass less easily,” which resembles the problem of *Pr.* 21.2, “Why does food made of wheat fasten most onto bodies, and why is it more nourishing than food made from barley?” The *De victu* does not here detail the mechanism of nutrition, but does repeatedly allude to moisture making loaves nutritious.²⁵ This perhaps inspires the *problema*’s explanation that wheat is stickier than barley, so that its particles stick to the body during digestion. The *problema* adds that crumbly barley-grains can have their nutritional value improved by kneading. This point may have been extracted from

22 Contrast, for example, Arist. *HA* 8.29.607a9–13, where both characteristics and looks of animals in rough mountainous places are contrasted with those of fertile plains. This may be influenced by *Aēr.* 24, but in *HA* the focus is switched from humans to animals. *Pol.* 7.7.1327b23–36 (cited by Louis) contrasts cold (and not hot) parts of Europe with Greeks and Asians in their characteristics (and not looks); *EN* 7.1.1145a29–31 and 7.5.1148b15–1149a20 (cited by Flashar) discuss being θηριώδης but without climatic causes.

23 *Pr.* 1.1–3 form a kind of introduction to disease (Ulacco 2011, 67–70), and indeed were bundled as such by Hunain in *PPA* 1.1. It is apt that the general approach of the most significant Hippocratic source (*Aēr.*) should feature here.

24 The vaguer similarity of *Pr.* 21.11 (about barley) to *Vict.* 2.41 (about wheat) could be significant given its proximity to the use of *Vict.* 2.40–42 in *Pr.* 21.2 and 21.8.

25 E.g. κοῦφος μὲν ἐστὶν ὅτι ἀπὸ τῆς ζύμης τοῦ δέξους τὸ ὑγρὸν προανάλωται, ὅπερ ἐστὶν ἡ τροφή, or later τῶν ἄρτων οἱ μέγιστοι τροφίμωτατοι, διότι ἤχιστα ἐκκαίονται ὑπὸ τοῦ πυρὸς τὸ ὑγρὸν. The work’s general claim is that nutritional health derives from a suitable balance of moisture and fire: e.g. *Vict.* 1.3, 7.

Vict. 2.40, where the catalogue of barley-breads specifies that “dry-kneaded” dough is more nutritious than moistened kneaded and moistened unkneaded dough. The Hippocratic text here also implies that the faster these breads pass through one’s system, the less nutriment is adsorbed. *Pr.* 21.8 picks up on this, but adds a further complication: why does kneading wheat-doughs, by contrast, make them pass less easily? This is not something addressed in the list of wheat-breads in *Vict.* 2.42. This time the *problema* gives an explanation for why kneading contributes to stickiness (which went unexplained in 21.2), which supplants the point in *Vict.* 2.40 that denser particles are less prone to clog up one’s passageways before being adsorbed to the flesh. In sum, if—as the multiple correspondences tend to suggest—these two *problemata* were indeed inspired by the passage of *De victu* rather than other ideas about the nutritional value of staples, then they tackle an extended passage, draw together separate claims mined from it, supply an explanation (that wheat is stickier), supplant some Hippocratic explanation (of why kneading barley is good), and add new material to it (about kneading wheat).²⁶

Two *problemata* from book 2 demonstrate a different sort of complexity in creating questions, in that they combine a Hippocratic passage with a mediating passage of the dominant source, Theophrastus’s *De sudore*.²⁷ *Pr.* 2.9 combines *Sud.* 27 with—again—*Airs Waters Places* 8.²⁸ The question (“Why, though the sun warms the naked more than the clothed, do the clothed sweat more?”) is more closely related to the Hippocratic (alleged) observation that a person sitting or walking in the sun sweats under their clothes but not where the skin is exposed (8.3). By contrast, Theophrastus’ focus is on a different point in *Aër.* 8.3, that people after exercise (Theophrastus specifies running rather than walking) sweat more *in the shade* than in the sunshine. All three texts explain that the sun boils off sweat from exposed flesh, but in both Theophrastus and *Pr.* 2.9 a further explanation is given: the sun closes up the pores.²⁹ Later in the book, *Pr.* 2.30 combines some dietetic advice from *De victu*

26 Another possible source here is Mnesitheos’ discussion of grains. In fr. 28 Bertier he states that wheat is easier to digest than barley; however, he goes on to say that unkneaded breads (no matter what the grain) cause flatulence and headaches.

27 Fragment 9 (Wimmer) on TLG, but see now Fortenbaugh (2003).

28 Flashar has a useful brief discussion, as does Fortenbaugh (2003, 116).

29 The *problema* uses συμμύω, which Theophrastus applies to the closing of pores in *Sud.* 22, 25, whereas it is generally used in gynaecological treatises in the Hippocratic corpus. The *problema* characteristically presents the two explanations—drying and pore-closing—as possible alternatives (πότερον ὅτι . . . ἢ διότι . . . “Is it firstly because . . . or because . . .?”) whereas Theophrastus has the two working in tandem (διὰ τὸ τὸν ἥλιον ἀναξηραίνειν καὶ πυκνοῦν τοὺς πόρους, “through the sun drying up and contracting the pores”).

2.63 with a Theophrastean passage (*Sud.* 39) which also seems to have drawn on the same Hippocratic source.³⁰ The *De victu* mentions that running while clothed produces more heat and sweat, but also pallor from unventilated flesh. Theophrastus notes that running while clothed (and, he adds, oiling one's cloak) produces pallor from unventilated warm flesh, and adds that naked running actively brings about a good complexion. The *problema* combines these to pose a more general question "Why is the sweat on a naked runner, even when it arises in less quantity, better than the sweat (on a runner) in a cloak?" Like the Hippocratic text, it begins with the fact that running in a cloak is hotter and sweatier work, and ignores Theophrastus' point about oil; like Theophrastus, it includes the benefits of naked running. In treating the shared point that lack of ventilation causes pallor, the *problema* uses the more up-to-date vocabulary of εὐπνοια (good ventilation) and κατάπνιξις (stifling) from Theophrastus, before ending with a further point about over-sleepers. Hence the same *problema* intelligently combines sources, selects explanatory terminology, and marshals further evidence.

The last two examples are unusual in that we can trace additions to Hippocratic material to the influence of Theophrastus. More often, elements from unidentifiable sources are added to produce a more precise question. The procedure can be traced in the edition of *Problemata* read (avidly) by Apollonius the Paradoxographer. Aristotle (fr. 750) explained in it why earwax, which is generally bitter, becomes sweet in those who are about to die of a chronic illness.³¹ This *problema* was surely inspired by *Epid.* 6.5.12 "In humans sweet earwax, unlike bitter, signals death." But by adding the more specific observation that the sweetness arises over the course of a chronic illness, it narrows down the scope for possible explanations. The significance of this can be seen from Galen's brief commentary (*in Hp. Epid.* 6.5.19), where after expressing disgust at the idea of tasting a patient's earwax he refers the sweetness to *syntexis* of the brain, without explicit reference to whether the illness is chronic as the *problema* would demand.

One sees this process of narrowing the question in *Pr.* 33.1, 33.5 and 33.17, behind which lies *Aphorisms* 6.13 "Someone gripped by hiccups is released from the hiccups by the supervention of sneezes." This becomes the question of 33.17 straightforwardly, but the explanation invokes further details: hiccups

30 Contrast *Pr.* 38.3, which is a close expansion on the Theophrastean passage alone.

31 ὁ ῥύπος... ἐν τοῖς ὠταρίοις γιγνόμενος, πικρὸς ὢν, ὅταν τελευτᾷ μέλλωσιν ἐν ταῖς μακραῖς νόσοις γλυκὺς γίγνεται, where Hercher's dubious bracketing of ὅταν τελευτᾷ μέλλωσιν (1876, 359) is accepted without comment by Gigon and by Giannini (1965, 132). Apollonius does not tell us Aristotle's reasoning.

start in the lung, unlike burps (963a39); holding the breath and taking vinegar also stop hiccups (963b4–5). These two further comments are incorporated into more specific questions in 33.1 (“Why does sneezing stop hiccups but not stop burps?”) and 33.5 (“Why do sneezing, holding the breath, and vinegar stop hiccups?”). Again, Galen’s explication—that hiccups are a type of spasm caused by fullness and that sneezing helps evacuate some excess fluid (18a.23 Kühn)—would need some tweaking to satisfy the fuller set of observations probed by *Pr.* 33.1. There is a fleeting sense here that the *Problemata* were a tool for ongoing research which often did achieve real refinements.³²

Similarly *Pr.* 14.7 compresses the discussion of people in marshlands at *Airs Waters Places* 7.2–6, by picking out for analysis the final assertion that they grow old before their time and cannot be long-lived because of their water-sources. However, the *problema* adds to the question a contrast with those living in well-ventilated places, which is not explicit in the source. The explanation then justifies this addition: whereas *Airs Waters Places* suggests that stagnant water causes ageing, the *problema* has a deeper theory that poor ventilation causes both stagnant water and ageing. *Pr.* 34.4 also combines delicate mining of a Hippocratic source with the further specification of material from elsewhere. It asks why tongues are used as medical signs, citing three cases—during fevers, when there are pustules, and when its colour is variegated.³³ The explanation on the last point speaks of the tongue being coloured as it filters multi-coloured liquids. This appears to be inspired by two nearby comments in *Epidemics* 6: 6.5.8 states without explanation that the tongue’s colour is a sign of the prevailing humour; then 6.5.10 explains that the tongue-colour is diagnostic because it matches the προστάσεις, the material which collects on the tongue’s surface. The *problema* extracts from *Epidemics* 6 a part of its

32 See also the relationship between *Pr.* 10.48 (“Why are those humans with spaced-out teeth generally short-lived?”) and 34.1, Arist. fr. 273 (15) *uitae brevis signa ponit raros dentes*, HA 2.3.501b20 (animals—not just humans—with more teeth live longer), and *Epid.* 2.6.1 (“The long-lived have more teeth”). This complex of sources is noted at Poschenrieder (1887, 17); Quarantotto (2011, 45–46) notes that the closing remark in *Pr.* 10.48, “One must also consider the case of other animals,” situates the *problema* within a broader research project.

33 The text is corrupt: διὰ τί αἱ γλῶσσαι σημαντικὸν πολλῶν; καὶ γὰρ τῶν πυρετῶν καὶ γὰρ [ἐν *pro* καὶ γὰρ edd.] τοῖς ὀξέσι νοσήμασι, καὶ ἐὰν χάλαζαι ἐνῶσιν, καὶ τῶν ποικίλων προβάτων ποικίλαι (963b34–35). Mayhew obelizes the last four words. The *problema*’s explanation more clearly discusses the three cases mentioned above, which suggests one should emend προβάτων. Given βάπτεται in 963b38, προβα<ψάν>των may deserve consideration, though the verb is very rare. For the relationship of *Pr.* 34.4 and *Epid.* 6.5.8–10, see also Bertier (1989, 269).

question and the corresponding part of its explanation, but it also supplements this with further instances where the tongue is a sign, and thence constructs a more general claim that it is the tongue's moistness which gives it signifying power.

Finally, *Pr.* 13.6 even raises an explicit objection to the more superficial passing comment on which it builds, *De morbis* 4.56: "Whenever we eat garlic or some other smelly food, our urine smells of the food" (given as evidence that drink goes to the stomach rather than the lungs). The *problema* first corrects the over-generalisation: "Why does the urine smell if someone eats garlic, but not smell when other strong-scented things are eaten?" Then it supplies possible explanations, the first of which draws on a "Heraclitean" theory, which is found wanting precisely for failing to distinguish garlic from other strongly scented foodstuffs.³⁴

4 Reapplying Hippocrates

I end with a few cases where Hippocratic passages seem to have been reapplied to explain issues not presupposed in the original context. *Pr.* 10.50, for example, asks why having a squint is largely peculiar to humans. The suggested solution is that strabismus is caused by epilepsy during youth, and the latter is itself an almost exclusively human trait. The connection between epilepsy and strabismus was perhaps inspired by the Hippocratic *Epidemics* 2.5.11, where it is stated without explanation that when the "Great Disease" becomes habitual, various symptoms including "skewing of the eyes" occur.³⁵ The question of the

34 These examples are more successful than *Pr.* 3.1, on why the drunk are prone to chills and pleurisy "though wine is warm." These last words appear to be added to the likely source, which Flashar identified as *De affectionibus* 7, in order to point the paradox—which, however, the *problema's* explanation does nothing to address. Nor does it relate drunkenness to pleurisy. Others (e.g. Poschenrieder [1887, 61], Louis, Mayhew) cite only *Morb.* 1.26 as the source, and I shall mention in the next section a possible use of *Morb.* 1.25. If this is right, the *problema's* explanation is even more simplistic, since *De morbis* gives a detailed explanation of how drinking causes chills and pleurisy in terms of the movements of bile and phlegm around the ribcage. Perhaps the different explanations given in *PPA* 4.1, 4.6 are attempted improvements by Hunain, rather than reflecting an earlier state of the text.

35 Cf. *Pr.* 31.26 (almost identical to 10.50), and 31.27 which suggests other explanations but includes at 960a19 the assertion ἡ δ' ἐπιληψις διαστροφὴν ποιεῖ ὅταν γένηται, "epilepsy causes skewing [sc. of the eyes] whenever it occurs."

problema, however, is unrelated to the Hippocratic text.³⁶ Similarly, *Pr.* 31.23, about the temperature of tears, supports its explanatory model with a notion drawn from *De morbis* 1.25, that cold sweats arise from the slight warming of a large amount of residue while warm sweats can only arise from a small amount of residue; this explains why cold sweats betoken a lengthy illness.³⁷ And *Pr.* 25.15 brings to bear the observation that “the South is hottest through being closest to the sun” (939b7, ἔστι δὲ ἡ μεσημβρία θερμότατον διὰ τὸ εἶναι ἐγγύτατον ἡλίου). This is very similar to one of the first comments in *De victu* 2—whose use we have seen repeatedly—that “A [country] situated towards the South is hotter . . . because it is very near the sun” (2.37 ἡ πρὸς μεσημβρίαν κειμένη θερμότερη . . . διότι ἐγγυτάτω τοῦ ἡλίου ἐστίν).³⁸

Finally, so that we may end where we began with the *Problemata* using *Airs Waters Places*, the question in *Pr.* 23.30, why the surface of the sea is saltier (and warmer) than its depths, is not raised in *Aër.* 8. However, the suggested explanation of the *problema* is closely related verbally: ἢ διότι ὁ ἥλιος καὶ ὁ ἀήρ ἀνάγει αἰεὶ τὸ ἐλαφρότατον ἀπὸ τῶν ὑγρῶν, τὸ δὲ ποτιμώτερον αἰεὶ κουφότερον; “Is it because the sun and air constantly draw up the most mobile part from liquids, and what is more potable is always lighter?” The Hippocratic text, while explaining the quality of rain via the physics of evaporation, asserts that ὁ ἥλιος ἀνάγει καὶ ἀναρπάζει τοῦ ὕδατος τὸ τε λεπτότατον καὶ κουφότατον. δῆλον δὲ οἱ ἄλλες ποιέουσιν, “The sun draws and snatches up the finest and lightest part of water; salt-pans make this clear” (8.2). This describes evaporation in similar language to the *problema*, and also connects it immediately to its effect of making the saltiness of the sea more noticeable.³⁹

36 Cf. the mention of marjoram (ὀρίγανος) as being bad for eyes at *Pr.* 31.9.958b8—a property mentioned at *Hp. Epid.* 5.54. Admittedly, this piece of plant-lore need not be tied down to a specific Hippocratic source.

37 This material is repackaged more straightforwardly in *Pr.* 2.35, without the application to the temperature of tears. The connection to *Morb.* 1.25 is made at Poschenrieder (1887, 60), and is more convincing than the connection to *Prog.* 6, which states that cold sweats signal a long illness, without giving any rationale. I suspect that Mayhew’s comparison of *Pr.* 2.35 to *Epid.* 7.25 (where cold sweat immediately precedes death) should read “*Morb.* 1.25.”

38 Poschenrieder (1887, 57) tentatively drew the parallel and noted the prominent position of this comment in *Vict.* 2. Flashar (1975, 340) suggests a nebulous, widespread use of *Vict.* 2 as well.

39 Flashar casts doubt on this connection by citing alternative sources for the theory of evaporation in *Pr.* 23.30. However, the only parallel with similar phrasing and an explicit link to the saltiness of the sea comes from a keen reader of Aristotle’s *Problemata*: Plutarch (*Quaest.Nat.* 9 [*Mor.* 914b–c]).

5 Conclusion

Throughout this chapter we have witnessed a range of ways in which the *Problemata* draw on the Hippocratic corpus. Clearly, given the fact that this engagement cannot be reduced to a simple pattern, and given the loss of other medical texts which the *Problemata* may have used, not every interaction proposed here will seem equally cogent. However, there is no room for doubt that *Pr.* 1.9 reordered *Aër.* 10 to clarify its structure, and I feel confident that the other instances of sophisticated interaction are not all merely the mirages of positivist source-chasing. Such interactions include refinements of the observation to be explained, which in some cases refute Galen's commentaries on the same passage. I mention that not as a cheap matter of points-scoring, but as indicating that *problemata* could contribute in real terms to the development of scientific models.

Of the Hippocratic texts, *Airs Waters Places*, *De victu* 2 and the *Epidemics* (esp. 6) seem to have been particularly influential; *De morbo sacro*, *De flatibus*, *De morbis*, *Aphorisms* 6 and *De affectionibus* have all made passing appearances, and doubtless research will continue to trace new parallels. Unlike their use of Theophrastus, the *Problemata* tend not just to "repackage" Hippocratic material in the *problema*-format. Often, it must have been precisely the unexplained assertion which attracted attention (e.g. in the *Epidemics*), and elsewhere Hippocratic explanations were felt to need more or less updating of terminology and physiological model—more, of course, than Theophrastus' texts required. The *Problemata* therefore stick, as far as Hippocratic material goes, largely to Aristotle's project for them, to explain natural phenomena whose causes are unclear (fr. 112, cited above).⁴⁰

Use of the Hippocratic Corpus characteristically does not come with any explicit ascription. While, as we saw, Aristotle sets up various kinds of *problemata* as being related to the opinions of prior thinkers, the physical *problemata* generally—and always in the Hippocratic cases—pose a question and suggest an answer without directing the reader to matters of authority. We saw from the contrast to Galen's commentaries that instead of a faithful explanation of the merits and (sometimes) demerits of lemmata from the Hippocratic texts, the *problemata* put the student into immediate contact with a curious phenomenon, and suggest tentative, often multiple, explanations without being restricted by what "Hippocrates" had declared. The openness of the text,

40 Cf., correct but unsurprising, Flashar (1975, 340): "der Stoff aus dem Corp. Hipp. vornehmlich für die Spitze der einzelnen Probleme gestellten Fragen verwendet wird, während die Antworten überwiegend von arist.-peripatetischen Erklärungsprinzipien bestimmt wird."

ever able to be expanded with the reader's own explanations, offers a vehicle for teaching which is remarkable for actively engaging the student and for its freedom from authoritarian principles. And we know that this format was appreciated: the various ancient editions which we can distinguish prove that ancient reading imposed revisions in the text, as well as implying a continuing readership whose enthusiasm is glimpsed so vividly in the representations of *problema*-reading in Plutarch and Gellius.

TABLE 3 *Summary of (only) the passages mentioned, ordered by Hippocratic source*

Hippocratic source	Pr.	Notes
<i>Aër.</i> 1, 11	1.3	Uses 1 vaguely and 11 in detail to form both question and explanation.
<i>Aër.</i> 7.2–6	14.7	Abbreviates to form question and construct a deeper explanation.
<i>Aër.</i> 8.2	23.30	Reapplies explanation (with phrasing preserved) to new question.
<i>Aër.</i> 8.3	2.9	Uses for question, combines with <i>Thphr. Sud.</i> 27 for explanation.
<i>Aër.</i> 8.8–10	fr. 760	Reformats proposition, explanation and evidence, with slight addition.
<i>Aër.</i> 10.3–12	1.8–12, 19–20	Adopts propositions nearly verbatim; explanations added, altered or reordered.
<i>Aër.</i> 24.2, 10	14.1	Extracts question from two separate sentences; supplies explanation.
<i>Aff.</i> 7	3.1	Adds to proposition, but supplies feeble explanation. (Possibly to be related instead to <i>Morb.</i> 1.26.)
<i>Aph.</i> 6.13	33.1, 5, 17	Uses for question of 33.17, to which refinements are made in explanation and in 33.1, 5.
<i>Epid.</i> 2.5.1	11.38	Uses in part to form more focussed question; adds explanation.
<i>Epid.</i> 2.5.11	10.50, 31.26–27	Reapplies proposition to new question.
<i>Epid.</i> 2.6.1	10.48, 34.1	Constructs slightly altered question, but unclear derivation because mediated by Arist. fr. 273, <i>HA</i> 2.3.

Hippocratic source	<i>Pr.</i>	Notes
<i>Epid.</i> 5.54	31.9	Possibly incorporates observation as a corollary of a separate piece of explanation.
<i>Epid.</i> 6.4.19	11.3	Adopts proposition; attempts to clarify Hippocratic explanation.
<i>Epid.</i> 6.5.1	34.12	Possibly uses in part to form more focussed question; adds explanation.
<i>Epid.</i> 6.5.8, 10	34.4	Adds further phenomena to construct more general question and explanation.
<i>Epid.</i> 6.5.12	fr. 750	Adds to proposition; supplied explanation (lost).
<i>Epid.</i> 6.5.15	1.50a, 4.16	Uses proposition with similar phrasing; adds explanation.
<i>Flat.</i> 7	35.9	Possibly abbreviates to form question, then adds weaker explanation.
<i>Morb.</i> 1.25	2.35, 31.23	Reformats proposition and explanation (2.35). Reapplies proposition and explanation to separate phenomenon (31.23). More likely source than <i>Prog.</i> 6.
<i>Morb.</i> 1.26	3.1	See on <i>Aff.</i> 7.
<i>Morb.</i> 4.56	13.6	Probably corrects proposition and supplies more suitable explanation.
<i>Morb.Sacr.</i>	30.1	Reference to use of 'sacred disease' by ἀρχαῖοι.
<i>Prog.</i> 3	6.3	Dubious use of proposition (Diocles more likely).
<i>Prog.</i> 6	2.35, 31.23	Dubious: see on <i>Morb.</i> 1.25.
<i>Vict.</i> 2.37	25.15	Reapplies explanation to new question.
<i>Vict.</i> 2.40, 42	21.2, 8	Probably extracts questions in complex way, supplying and altering explanations, with further additions.
<i>Vict.</i> 2.41	21.11	Dubious use for question.
<i>Vict.</i> 2.62	fr. 736	Possibly uses for question; modifies explanation.
<i>Vict.</i> 2.63	2.30	Combines with Thphr. <i>Sud.</i> 39 to produce broader question and for explanation.
<i>Vict.</i> 2.65–66	5.6	Uses phrasing of 2.65 for question, and also gist of 2.66 in explanation.

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On *Problemata* 3: Wine-Drinking and Drunkenness

William W. Fortenbaugh

1 The Peripatetic Background

The drinking of wine and drunkenness was a topic of interest among the early Peripatetics. Diogenes Laertius' catalogue of Aristotelian writings contains the title *Symposium* (5.22). It comes tenth among the dialogues, with which the catalogue begins. An alternative title, *On Drunkenness*, is used by Athenaeus to refer to the same work.¹ Indeed, the work may have carried the double title *Symposium or On Drunkenness*.² Theophrastus too wrote a work entitled *On Drunkenness*. It is listed in Diogenes' catalogue of Theophrastean writings (5.44) and was used by Athenaeus, with and without title.³ Like the Aristotelian work, that of Theophrastus will have been a dialogue.⁴ In addition, both Hieronymus and Chamaeleon are reported to have written works that carried the title *On Drunkenness*. The work of the former is cited twice by Athenaeus,⁵ and that of the latter twice by Athenaeus and once by Clement of Alexandria.⁶ Most likely these works as well were dialogues. In all four works,

1 Athenaeus, *The Sophists at Dinner*, cites the Aristotelian work seven times, using the title *On Drunkenness*: 2.22.44D = 103 Rose³, 10.34.429C = 107, 10.67.447A = 106, 11.11.464B–C = 110, 11.95.496F = 111, 14.47.641B = 104 and 14.48.641D = 104. He cites it once using the title *Symposium*: 15.16.674F = 101.

2 See Moraux (1951, 33 n. 33), who compares *On Soul*, which Diogenes lists among the dialogues and without its alternate title, *Eudemus* (5.22). In Rose³, the *Symposium or On Drunkenness* comes sixteenth among the dialogues (1886, 97–104).

3 Athenaeus cites the Theophrastean work seven times with the title *On Drunkenness*: 10.22.423F = 574 FHS&G, 10.24.424E = 576, 10.30.427D = 570, 11.8.463C = 569, 11.13.465B = 573, 11.97.497E = 575, 15.48.693C = 572. Without title three times 10.33.429B = 579B, 10.45.435A = 578, 11.18.782A = 571. Plutarch cites Theophrastus without title twice: *Table Talk* 5.5.2.679A = 577A, 7.10.2.716A = 577B.

4 See Fortenbaugh (2011, 222–26, 706–37).

5 Athenaeus cites Hieronymus twice with the title *On Drunkenness*: 10.24.425A = 28 White, 11.101.500A = 29. See also 10.45.435A = 30, where Athenaeus cites the *Letters* of Hieronymus.

6 Athenaeus cites Chamaeleon twice with the title *On Drunkenness*: 10.29.427B = 11 Martano and 11.4.461A = 10 and twice without title 1.41.22E = 12 and 10.35.430A = 13. Clement of

the conversation will have been presented as taking place at a symposium. A variety of topics were discussed: not only drinking mixed and unmixed wine, sobriety and drunkenness, but also the games and rituals that took place during symposia, lexical issues related to drinking and drunkenness, legislation intended to control drinking and the physiological consequences of drinking, both good and bad. In regard to good consequences, one thinks of drinking as a way to relieve the despondency of old age, and in regard to bad consequences one might cite a loss of sexual drive due to heavy drinking.⁷

Given such a variety of topics, it would be unreasonable to believe that the dialogue format had an exclusive claim on discussions of drinking and drunkenness. An ethical treatise (an esoteric work used in teaching within the Peripatos) might consider the behavioral consequences of heavy drinking, and a political treatise might suggest legislation intended to curb excess. A lexicon might list words that are either peculiar to the use of wine or acquire a special meaning when used in regard to heavy drinking. And a scientific treatise focusing on human physiology might have much to say about the effects of drunkenness. An example of the last is our special concern: namely, Book 3 of the pseudo-Aristotelian work entitled *Φυσικά προβλήματα* (*Physical Problems*). The heading to Book 3 runs: "Ὅσα περὶ οἶνοποσίαν καὶ μέθην, "Those [Problems] Which Concern Wine-drinking and Drunkenness." Taken by itself, the heading might be thought to open the door to a variety of issues, ethical, political, lexical, etc., all dealing with wine and drunkenness. But on the whole that is not what we find in *Pr.* 3. The focus is on physiology as might be expected when one keeps in mind the title of the work, i.e., *Physical Problems*. In the heading to *Pr.* 3, the relative ὅσα connects with the title *Φυσικά προβλήματα*,⁸ and that limits the range of topics that will be discussed.

Alexandria cites Chamaeleon once with title (*Stromata* 1.26.170.3 = 14). For discussion, see Fortenbaugh (2012, 372–86).

7 Regarding the variety of topics discussed in the Theophrastean work, see Fortenbaugh (2011, 223).

8 That *προβλήματα* is to be understood with ὅσα seems to me quite certain. It should, however, be noted that in several manuscripts including the earliest and best (codex Parisinus 2036), the connection between the title *Φυσικά προβλήματα* and the first problem (introduced by ὅσα) is not immediate. The phrase κατ' εἶδος συναγωγῆς comes between the two. In my judgment, the phrase is a descriptive addition and not to be construed as part of the title. For discussion see Fortenbaugh (2013, 81–82 n. 40).

2 The Structure of *Pr.* 3

Pr. 3 is neither the longest nor the shortest of the thirty-eight books that make up the pseudo-Aristotelian *Problems*. The longest is *Pr.* 10, which runs for close to eight Bekker pages (891a6–898b25); the shortest is *Pr.* 36, a brief note that runs less than a quarter of a Bekker page (965a1–17). *Pr.* 3 is one of the longest, running some five and one-third Bekker pages (871a1–876a27). The chapters that constitute *Pr.* 3 number thirty-five and vary considerably in length. The shortest is ch. 24, which runs for two Bekker lines plus one word.⁹ Longest are two parallel/repetitive chapters of almost equal length: ch. 5, which is forty-three plus lines long, and ch. 26, which is forty-four plus lines. These repetitive chapters will be discussed below in Section 3.

In regard to format, each of the thirty-five chapters of *Pr.* 3 begins with a question whose opening words are διὰ τί, “For what reason” or simply “Why”. The phrase is everyday Greek, but in the context of the *Physical Problems* it becomes formulaic and is found throughout the work.¹⁰ In *Pr.* 3, διὰ τί almost always introduces a single question. We do, however, find διὰ τί introducing a compound question, i.e., two closely related questions joined by καί, “and” (35).¹¹ We also find διὰ τί repeated, so that two questions are clearly indicated (12). On one occasion, the manuscript tradition is faulty: what appears to be a single answer to a single question is in fact two answers, the second

9 Ch. 35 runs for two Bekker lines plus three words. Chs. 28, 4, and 29 exceed three lines by one, three and five words respectively.

10 Mayhew (2011, xiii n. 1) reports that in his edition there are 903 chapters, of which 98 percent begin with διὰ τί. While the phrase διὰ τί may suggest Aristotle’s efficient cause, its use is not restricted to questions concerning the efficient cause. See Arist. *Phys.* 2.3.194b19 and [Arist.] *Pr.* 4.15.878b1–2, cited by Fortenbaugh (2013, 80–81 n. 38).

11 Ch. 35 is quite short (see above, n. 9); indeed, so short that one suspects heavy-handed abbreviation or even corruption in the course of transmission. The bipartite question runs: Διὰ τί τὸ ἔλαιον πρὸς τὰς μέθας συμφέρει, καὶ τοῦ δύνασθαι πίνειν τὸ καταρροφεῖν; “Why is olive oil beneficial in regard to drunkenness and why does sipping it enable one to drink?” The translation is that of Mayhew, who follows Forster closely. It is unobjectionable; I merely add that the second part of the question begins with an objective genitive, i.e., τοῦ δύνασθαι πίνειν, and that the verb ἔστι is understood. A more literal (and awkward) translation might be, “Why is sipping for being able to drink?” The answer is suspiciously brief: ἢ διότι οὐρητικὸν ἔστι καὶ τῷ πόματι προοδοποιεῖ; “Is it because it is a diuretic and prepares the way for drinking?” (876a26–28). The occurrence of καὶ in the answer creates two parts, and therefore the impression that two questions or both parts of the bipartite question are being answered. But it is also possible to understand the καὶ as epexegetical: the importance of being diuretic is explained as making it possible to continue drinking. I leave the matter undecided.

question having been lost in transmission (25).¹² An emendation in the form of a διὰ τί question is provided by a marginal note. It is printed in the texts of both Hett and Mayhew, but it is rejected, correctly I believe, by Flashar, who cites Forster.¹³

The answers that follow on the questions are typically introduced by formulaic words and phrases that exhibit variation. Most common is the use of the interrogative particle ἤ, in which the interrogative force is suppressed and the answer that follows has the feel of a modest or tentative assertion.¹⁴ The particle can be used by itself (e.g., 10, 12) or in combination with διότι (e.g. 1, 32) or ὅτι (e.g. 4, 7). Sometimes a single answer is offered (e.g. 1, 4), but on other occasions we find two, three and even four answers proposed (e.g., 34, 26, 5, respectively). Occasionally πότερον occurs. It may introduce the first of two possible answers (3), which is in line with common usage (“whether . . . or”); but on one occasion it stands at the head of four alternatives (31).

The conjunctive combination ἔτι δέ is used to introduce a further consideration, for example in ch. 3, where it occurs after two answers to the question: “Why do those who drink partially unmixed wine have a worse hangover than those who drink it completely unmixed?” The first answer is that being lighter partially unmixed wine penetrates into further and narrower regions. The second answer is that persons who drink unmixed wine drink less and vomit more. Then comes ἔτι δέ, followed by the assertion that unmixed wine causes concoction elsewhere and in itself (871a21–22). If I understand correctly, the author has used ἔτι δέ, “furthermore,” because he does not view the assertion as an alternative to the preceding two suggestions. He views it as compatible with and supplementary to the second alternative, which is also focused on unmixed wine.¹⁵

12 Hett assigns the two problems different numbers: 25 and 25a. He is followed by Flashar (1962, 43). Mayhew prefers 25a and 25b. He characterizes the first as “a mangled and/or incomplete version of *Pr.* 3.12” (2011, 123 n.44).

13 Flashar (1962, 450–51) cites Forster without referring to a particular work. The reference is to Forster (1927), whose n. 3 to ch. 25b convincingly defends the question that is added to the text in order to create a new problem. In the reprint of Forster’s translation in Barnes (1984, 2: 1347), the added question has been changed, presumably in order to bring it into line with the marginal note. The lack of any footnote defending the change may be in line with editorial policy, but in this case the failure to explain the change is regrettable.

14 See Flashar (1962, 341) and Bonitz’s *Index Aristotelicus* 312b56–313a35. Among the passages cited by Bonitz, cf. *EN* 1.5(7).1097a18, 3.1.1110b1 and 3.9(6).1115a25, 29.

15 Cf. the use of ἔτι δέ in ch. 29. For ἔτι without δέ see ch. 2, where the assertion that tipsy persons judge and do so poorly is not an alternative to the preceding explanation that tipsy

On occasion the answer(s) do not follow straightway on the question. There occurs a comment, which Flashar characterizes as *ein selbstständiger Zwischenteil*:¹⁶ we might say “intermediate material.” Often the comment introduces a paradox, making clear why the question needs consideration. For example, having asked, “Why when people drink much continuously, do their stomachs become drier?” the author adds “when [the stomachs] ought to become wetter due to the greater intake?” (21.874a22–23). Or again, having asked why people who are thin die from drinking unmixed wine and others who are not so thin become dry by drinking much at once, the author adds, “For (γάρ) both wine and living seem to be by nature things that are hot, whereas dying is a matter of cooling” (23.874a38). Here γάρ signals a clarification: the author spells out the paradox involved in the immediately preceding questions. There is no necessary limit to the length of an intermediate comment, so that we should not be surprised to find one or two longer comments, which seem to take on a life of their own—e.g. chs. 5 and 26 (especially the latter), in which the comment becomes a quasi-introduction to the subsequent answer. See Section 3 below.

From the standpoint of content, *Pr.* 3 is like virtually every book of the *Problems* in that it is lacking in structure or organization. To be sure there is a heading that delimits the questions to be asked: they will concern drinking and drunkenness. Furthermore, there are chapters that are appropriately placed next to each other: chs. 12 and 13 both concern sweet wine and recognize its beneficial effect as a prophylactic against drunkenness. In addition, ch. 13 makes reference to ch. 12 regarding the connection between drunkenness and heat in the region around the head.¹⁷ Chs. 9 and 10 are similar in that they both concern vision, and the later refers to the former.¹⁸ But there are also chapters that tell against good organization. A clear example is ch. 35, which concerns olive oil as a prophylactic against drunkenness and for that reason might have been grouped together with chs. 12 and 13. Moreover, ch. 35 is quite short and most likely found its place at the end of *Pr.* 3 for no other reason than that it was a leftover scrap that had to go somewhere. Most striking, however, are the repetitions: i.e., repetitive chapters that address the same question, which is often phrased in the same words and followed by comments that also make use of the same or similar wording. As an example, I cite chs. 9 and 20, which but for

persons have not drunk so little that they are sober and so much that they are undone. Rather, it supplements and clarifies what precedes.

16 Flashar (1962, 342).

17 13.873a1 referring to 12.872b30–31.

18 10.872b5 referring to 9.872a21–22.

two words begin with an identically phrased question: “Why does everything appear to be traveling in a circle to those who are very drunk, and as soon as drunkenness has grabbed them they are unable to observe things far away?”¹⁹ The two chapters go on to offer an answer in identical wording, “Is it because the vision is often moved by the heat of the wine?”²⁰ A slightly more complicated example is provided by chs. 29 and 32. Both address the problem, why do drunkards enjoy being warmed by the sun, and in answering the question both refer to concoction and to apoplexy. But ch. 32 does not limit the question to drunkards; those living around the sea are included.²¹ In the immediately following section, I shall continue the discussion of repetitive chapters, focusing on chs. 5 and 26, in which cooling and trembling are of primary concern. Here I simply assert that the occurrence of repetitive chapters separated from each other and lacking cross-references speaks for more than one author. We should think of various compilers drawing on closely related sources, some of which go back to a common source.²²

3 Two Repetitive Chapters: *Pr.* 3.5 & 26

Chs. 5 and 26 are the two longest in *Pr.* 3. They are also roughly equal in length,²³ take their start from the same question—“Why do drunkards tremble, and more so according to how much unmixed wine they drink?”—and provide intermediate material.²⁴ The similarity is striking, but so are the differences. Ch. 26 provides more intermediate material and ch. 5 more answers to the question under consideration.

19 Ch. 9 (Mayhew trans.). In ch. 20, “more” is added after “has grabbed” (ἀπτομένης μάλλον) and “to observe” is replaced by “to count” (ἀριθμεῖν) (both 874a6).

20 After the initial answer (i.e., after 9.872a22 and 20.874a9), the two chapters exhibit considerable difference. I return to chs. 9 and 20 in Section 4 below.

21 In ch. 29, the question runs, “Why do drunkards in particular/especially (μάλιστα, 875b6) enjoy being warmed by the sun?” The occurrence of μάλιστα is an acknowledgement that others too enjoy being warmed in the sun. Given the question as expanded in ch. 32, we can say that the others include those living around the sea. It is possible that the author of 29 knew the question as formulated in 32 and chose to simplify the question, letting μάλιστα stand for those around the sea (and others as well).

22 For discussion of repetitions, see Flashar (1962, 323–25), who refers to Prantl (1851, 345–47).

23 In Bekker’s edition, both chapters run 44 plus lines. Ch. 26 is longer by one third of a line.

24 On intermediate material, see above, Section 2, p. 104.

I begin with ch. 5, in which we are told that wine is capable of heating, and trembling results from cooling. In addition we are told that powerful trembling is experienced by many persons whose only nourishment is unmixed wine. Indeed, such persons throw off those who are restraining them,²⁵ and when they wash in warm water they have no feeling of the warmth (871a27–33). After these intermediate comments, the author begins his explanation with the formulaic phrase ἦ ὅτι. He first repeats the idea that cooling is the cause of trembling and then recognizes four ways in which cooling occurs. Each is introduced by ἦ: (1) either when a person's internal heat is surrounded by external cold as in winter, (2) or when a person's natural heat is extinguished by its opposite, i.e. cold, (3) or on account of time as in old age, or (4) through an excess of alien heat (871a33–37). The last is immediately illustrated by reference to the sun and to fire,²⁶ and by the statement that the heat of unmixed wine is increased when it is mixed with the heat proper to the body; it extinguishes the latter, so that the body is cooled and trembling occurs (871a38–b4).²⁷

25 “Those who are restraining them” (Mayhew), “those who hold them” (Hett) and “those who are trying to hold them down” (Forster) translate ἐλβεῖν, which recurs in 26.874b27. It is a conjecture without merit. See Flashar (1962, 439–40), who argues that ἐλβεῖν means “to press” and not “to hold down.” Moreover, it is odd to think of someone shivering with such force that he throws off those who seek to restrain him. More plausible might be throwing off a cloak. My preference would be to insert daggers into the Greek text and to leave the participle untranslated.

26 The idea that a larger fire can quench a smaller one is Aristotelian, but it is not original with him. That is made clear in *On Generation and Corruption*, where Aristotle first speaks of earlier philosophers and then tells us what they say concerning smaller and larger fires: namely, that the smaller is destroyed by the larger (1.7.323b1–9). In *On Youth and Old Age*, Aristotle explains why a smaller fire dies down in the presence of a greater one. He compares the flame of a lamp when placed in a greater flame and says that the greater flame seizes the nutriment/fuel in the smaller flame (5.469b31–470a 3). Commenting on this passage, Ross (1955, 303) writes, “A’s meaning seems to be that when a small flame is set close to a big one, not only does the small flame dwindle (i.e. seems to dwindle) in comparison with the larger, but it dwindles in reality because the larger flame steals its fuel from it, before fresh fuel arrives.”

27 Cf. *Pr.* 3.23 where we read, “Wine by its own heat causes the natural heat to waste away. Therefore, just as a little fire is extinguished by a large fire or by the sun, so too the heat in the body is extinguished by that in the wine. If the latter surpasses it” (874b14–17). The idea is that unmixed wine brings to the body additional heat, which combines with the heat proper to body. The latter is dependent on moisture which is present in the body and which fuels the heat of the body. That moisture is drawn upon in order to support the increased heat. The result is a reduction in the requisite moisture and a cooling of the body. See the conclusion of this paragraph on 874b21–31.

At this point, the author announces still another manner of cooling beyond those already mentioned: ἔστιν δὲ καὶ παρὰ πάντα τὰ εἰρημένα ἄλλος τρόπος καταψύξεως (871b3–4). It is the removal of the matter, ὕλη (871b5), by which the warmth of an individual is nourished. The idea is illustrated by reference to an inanimate object, a lamp. When the oil is used up, the light is extinguished. So, too, in an animate object. When that which nourishes heat is removed or reduced, then heat fails. And this we are told is what happens in old age and when diseases are long and wasting (871b4–11). Illustrating the animate with the inanimate is helpful. We understand that a lamp gives off light when it has not only a supply of fuel but also a particular kind of fuel, namely, oil. Similarly the body of a person is warmed not simply by a supply of moisture but by moisture of a particular kind, namely, moisture that is smooth and oily (871b13, 15–16). There is, however, a problem. Old age has already been mentioned in the previous list of ways in which cooling occurs (it comes third), so that the claim to be introducing another manner of cooling not already mentioned is odd if not outright false. Be that as it may, the author continues to consider failing heat due to changes in nutritive moisture (871b13–21), after which he returns to drinking unmixed wine and the fourth manner of cooling. We are told that when the heat of unmixed wine is combined with the heat that is present by nature, then together they more readily use up the supply of moisture that supports the natural heat of the body.²⁸ As a result some persons become dropsical, others rheumatic and still others are affected in the stomach. For the moisture that remains is harsh and what is taken in (ingested) is soft and does not thicken on account of the weakness of the heat that is proper to the body, δι' ἀσθενείαν τοῦ οἰκείου θερμοῦ (871b27–28). And the heat is weak, because the matter in which it is preserved is weak, τῷ τὴν ὕλην εἶναι τοιαύτην ἐν ᾧ ἔτι σῶζεται.²⁹ It is like the heat given off by a fire of reeds, when compared with that given off by logs (871b29–31).

28 The Greek runs: μάλλον ἀναλίσκει τὰ ἐν τῷ σώματι ὑπάρχοντα ἐφόδια τῷ οἰκίῳ θερμῷ (871b23–24). The noun ἐφόδια refers first to supplies for traveling and then more generally to ways-and-means that support various things. For the dative, cf. Demosthenes, *Orations (Against Timotheus)* 49.67: ἐφόδια τῷ γήρῳ ἱκανά, “sufficient provisions for old age.” For ἐφόδια in combination with ἀναλίσκειν, cf. Demosthenes *Or.* 19 (*On the Embassy*) 311, where the meaning is “to pay travel expenses.” At *Pr.* 871b23–24 the idea is expending or using up the supply of moisture that is present in the body and required for heating the body. See LSJ s.v. ἐφόδιον(ια) 1, where *Pr.* 871b24 is cited. Instead of ἀναλίσκειν, we find καταναλίσκειν used by Aristotle in *On Youth and Old Age* 5.469b29, 31.

29 The matter, ὕλη (871b30, cf. 871b5), is the supply of moisture present in the body for its own heat (871b23–24, referred to in the preceding note).

As already stated, ch. 26 is like ch. 5 in beginning with the same question “Why do drunkards tremble, and more so according to how much unmixed wine they drink?” It also continues with intermediate material, which is all but identical with the intermediate material found in ch. 5 (cf. 5.871a27–33 and 26.874b22–27); but ch. 26 goes beyond ch. 5 by making reference to drinkers of unmixed wine who have massages and eat meat. They are said to be seized by apoplectic fits, to tremble less, to experience severe pain, and to be unable to remain at rest (26.874b28–31). At this point, the author takes a step backwards, saying: ἔτι τοῦ μὲν τρόμου αἰτία ἢ ψυχρότης· φαίνονται γάρ, ὥσπερ εἴρηται, οἳ τε ῥιγῶντες τοῦτο πάσχοντες καὶ οἱ σφόδρα γέροντες. ἀμφοτέρων δὲ τούτων τῶν μὲν τὸ πάθος ψυχρόν, τῶν δὲ ἢ ἡλικία, “Still,³⁰ coldness is the cause of trembling; for as was said,³¹ persons who are chilled seem to experience this, as do persons who are exceedingly old. Of these two, the condition (πάθος)³² of the former is cold and of the latter [old] age” (874b31–35). The author leaves it to the reader to understand that old age involves a failure of heat and therefore a cooling of the body. What the author does do is turn the reader’s attention to the central issue of the chapter: “Wine is capable of heating, so that the opposite should occur” (874b35–36). I.e., heavy drinkers should be warmed rather than chilled and therefore should not experience trembling which is caused by coldness. What follows is a first step in resolving the problem.

The author says, ἢ οὐθὲν κωλύει γίνεσθαι ταῦτὸ ὑπὸ ἐναντίων, μὴ ὡσαύτως δὲ ποιούντων, “Or does nothing prevent the same thing occurring on account of opposite causes, but not acting in the same way” (874b36–37). The idea is elucidated by the example of frost and heat. Both cause burning, but in the case of frost the burning depends upon frost causing heat to collect (874b37–875a2). Next we are told that trembling occurs on account of lack of heat, but not any heat; rather, it is the heat that is proper, οἰκεῖον, to the body (875a2–3, we are familiar with this use of οἰκεῖον from 5.871b27). The author continues

30 Hett omits ἔτι at 3.26.874b31; Mayhew prints ἔτι but does not translate it. The omission has some manuscript support, but ἔτι is found in the oldest and best codex (10th century) and is being used to indicate a weak break with what has just been said: i.e., that persons who drink unmixed wine and also have massages and eat meat are less afflicted by trembling. The author wants to reaffirm and strengthen the connection of trembling with cooling and chooses to do so, beginning with ἔτι, “still” (cf. LSJ s.v. II).

31 See 874b23–24.

32 Πάθος is used of the physiological condition of the person who experiences chills and trembling. This usage is not to be confused with using πάθος to refer to an emotional response like anger or fright, whose cause is cognitive, i.e., a particular belief. For a single use of πάθος covering both a physiological condition (dying) and an emotional condition/response (fright), see *Pr.* 4.7 877a25, discussed briefly below in Section 4, p. 122.

by listing three ways in which the heat proper to the body is reduced. Each is introduced by ἤ: (1) either by fading or wasting away, μάρανσει, (2) or by being extinguished, σβέσει, (3) or by heat that is alien (not proper to the body), ὑπὸ θερμοῦ ἄλλοτρίου (875a4–7). Wasting away is explained by lack of nourishment and illustrated by lamps that lack fuel or oil. Being extinguished is explained by what is opposite: namely, the cold and moist.³³ And alien heat is illustrated by the sun in relation to a fire and by fire burning near a lamp (already familiar from ch. 5.871a38). The three alternatives are then discussed: first comes being extinguished, then wasting away, and finally being overwhelmed by alien heat (875a7–28).

There are obvious differences between chs. 5 and 26. I have already taken note of the additional intermediate material in ch. 26. Other differences include, e.g., the diseases that are mentioned (ch. 5 speaks of dropsical and rheumatic individuals [871b24–25], ch. 26 of those who are seized by apoplectic fits [874b29]), the examples/comparisons that are put forward (ch. 5 refers to reed fires [871b29–31] and ch. 26 compares the weak individual who cannot control a large plank [875a21–24]) and the quasi-technical terms that are used (ch. 5 distinguishes between things ἄψυχα and ἔμψυχα [871b7–9]³⁴ and ch. 26 uses πάθος when referring to a physiological condition [874b34]).³⁵ Here I want to call attention to a structural/stylistic detail: namely a difference in the use of ἤ. In ch. 5, the conjunction is used four times to list the ways in which cooling is caused (871a33–37). In ch. 26 it is also used four times: the first introduces a general answer or principle—opposite causes can have the same effect but not in the same way (875b36–37)—and the other three list specific causes (875a7–14). In what follows, the three occurrences are underscored by the phrase τρίτος τρόπος (875a18). The author is, as it were, announcing that he has finished discussing two of the ways in which warmth is replaced by coldness and is now turning to the third and last. A possible explanation of the difference can be hazarded. The author of ch. 5 has chosen to begin his list with the most common case: in cold weather, especially winter, a person is frequently surrounded

33 In reporting the explanations of wasting away, μάρανσις, and being extinguished, σβέσις (875a4–7), I have kept to the order in which the two are first introduced (875a4). In fact, the author reverses the order when giving the explanations. In *On Youth and Old Age*, Aristotle mentions μάρανσις before σβέσις and explains the terms in the same order (5.469b21–23). I agree with Flashar (1962, 441) that the reference to old age and force need not be expunged. They offer further clarification and maintain the order.

34 Cf. *Pr.* 16 and 17, which carry the headings "Ὅσα περὶ τὰ ἄψυχα (913a18) and "Ὅσα περὶ τὰ ἔμψυχα (915b37) respectively.

35 See above, n. 36.

by cold air, to which he (his body) responds by shivering (871a34–35). Extreme cases aside, the response is superficial and easily remedied by putting on thick clothing or entering a warm room. The author of ch. 26 chooses to ignore this common experience³⁶ and to focus on the more interesting cases listed by the author of ch. 5. Only he reorders the cases: what comes third in ch. 5 (871a36) is mentioned first and followed by (875a4) what precedes in ch. 5 (871a35–36).³⁷ After that the author of ch. 26 immediately reverts to the order found in ch. 5, placing third (875a7–8) what comes fourth in ch. 5 (871a37–38). Such a minor and potentially confusing change in order, together with the emphatic use of τρίτος τρόπος (875a18–19), might suggest a weak attempt to escape the charge of copycat, but that is too simplistic. Moreover, it may have things backwards. It is also possible that the author of ch. 5 has chosen to make an addition to the list in ch. 26: he values completeness and therefore makes reference to external cold in winter (871a34–35). And when the author of ch. 26 reverts to the order of ch. 5, he need not be seen as taking a cue from that chapter. He may simply prefer to procede ὕστερον-πρότερον.

4 Theophrastean Precedents

In the course of the twentieth century, it came to be recognized that the *Physical Problems*, which forms part of our *corpus Aristotelicum*, is neither the work of Aristotle nor that of his pupil Theophrastus. Rather it is a later compilation that was put together, at least for the most part, during the Hellenistic period by various members of the Peripatetic School. *Pace* Strabo (3.1.54 = Thphr. fr. 37 FHS&G), these Peripatetics had access to many of the writings of Aristotle and Theophrastus;³⁸ and in compiling the *Physical Problems*,

36 The author of ch. 26 might say that this common experience is already covered by general statements made in the intermediate material: “Those who experience cold shiver most of all” (874b25) and “The cause of trembling is cold” (874b32). The first of these is found in the intermediate material in ch. 5, while the second is found in material added by the author of ch. 26. That could be significant. The author of ch. 26 both adds and omits, perhaps thinking that an earlier addition allows a later omission. I do not press the suggestion.

37 What comes third in ch. 5 is the diminution of natural heat through time such as old age, γήρας (871a5). In ch. 26 it is mentioned first, albeit without a clear reference to old age, μαράνσει (875a4). That comes later: ἐν δὲ τῷ γήρει τὸ θερμὸν μαράνιεται (875a14). What comes second in ch. 5 is the extinction of natural heat through its opposite, τῷ ἐναντίῳ (871a36). In ch. 26 it is mentioned second, ὑπὸ τῶν ἐναντίων (875a5).

38 See Barnes (1997, 12–16).

they drew upon those writings that appeared relevant. To make the point, I refer to four of Theophrastus' scientific *opuscula*: *On Sweat* is drawn upon in *Pr.* 2 ("Those [Problems] Which Concern Sweat"), *On Fatigue* in *Pr.* 5 ("Those Which Arise from Fatigue"), *On Winds* in *Pr.* 26 ("Those Which Concern the Winds"), and *On Odors* in *Pr.* 12–13 ("Those Which Concern Fragrant Things" and "Those Which Concern Malodorous Things").³⁹ Given the obvious relationship between the Theophrastean titles and the several Book headings, it is not surprising that the former were drawn upon in composing the latter. But borrowings are not confined to books whose headings are closely related to Theophrastean titles. Later in this section I shall mention passages in several different books, all of which relate closely to a particular passage in *On Fatigue*, and only one of which refers to fatigue in the heading to the book in question. But first I want to call attention to the fact that related passages in the *Problems* can be helpful in establishing the text of a Theophrastean *opusculum* and *vice versa*. Regarding the former, I refer to remarks in the introduction to my edition of *On Sweat*.⁴⁰ Concerning the latter, I refer to *Pr.* 3.20, which may serve as a caveat regarding unnecessary emendation.

Ch. 20 (already referred to toward the end of Section 2) begins in formulaic manner with a question introduced by διὰ τί: "Why does everything appear to those who are very drunk to be traveling in a circle, and as soon as drunkenness has seized them more, they are unable to count things far away?" There follows an intermediate comment, "And this is why some make this a sign of drunkenness." After that comes the answer beginning with ἢ ὅτι (874a5–8). The question and the intermediate comment are also found in all but identical wording at the beginning of ch. 9.⁴¹ Quite unimportant is a difference in word order in the intermediate comment.⁴² More interesting is the variation in the second half of the question.⁴³ In ch. 20 we read καὶ ἡδὴ ἀπτομένης μάλλον τῆς μέθης ἀριθμεῖν τὰ πόρρω οὐ δύνανται, "And as soon as drunkenness has seized them *more*, they are unable *to count* things far away" (20.874a6–7).⁴⁴ In ch. 9, we have the following: ἡδὴ ἀπτομένης τῆς μέθης ἀθρεῖν τὰ πόρρω οὐ δύνανται, "And

39 Regarding *On Sweat*, *On Dizziness*, and *On Fatigue*, see Fortenbaugh et al. (2003, 12–15, 178, 256). An edition of *On Winds* by Robert Mayhew will be published by Brill.

40 Fortenbaugh et al. (2003, 12–15).

41 In regard to the question and intermediate material, ch. 9 and 20 are strikingly repetitive, but their answers exhibit difference.

42 ποιοῦνται αὐτό τινες (20.874a7–8) and αὐτὸ ποιοῦνταιί τινες (9.872a20–21).

43 We might say that the question is in fact two questions, but that is not my concern here.

44 My translation departs from that of Mayhew, who introduces variation: "grabbed" (872a19) versus "seized" (874a6) and "are unable" (872a20) versus "cannot" (874a22). That is trivial, but such variation may mislead the Greekless reader into thinking that the divergence between the two texts is greater than it is.

as soon as drunkenness has seized them, they are unable *to observe* things far away” (9.872a19–20). Citing Bonitz and Klek, Flashar states that ἀριθμεῖν in ch. 20 should be emended to read ἄθρεῖν as in ch. 9. He translates accordingly.⁴⁵ Perhaps Flashar is correct, but if we are going to follow ch. 9, then we might delete μάλλον in ch. 20.⁴⁶ Moreover and more importantly, the reading ἀριθμεῖν has a parallel in Theophrastus’ *opusculum On Dizziness* 12, where the topic is the dizziness experienced by persons who take drugs and persons who drink heavily. There we read ὅταν γὰρ μὴ δύναται τις τοὺς στρωτήρας ἢ τὰς δοκοὺς ἀριθμεῖν, τὸν μὲν οὕτω κεκαθάρθαι τὸν δὲ μεθύειν <φασίν>, “For when someone cannot count the rafters or the roof-beams, <they say> that the one is not purged, and the other drunk” (94–96 Sharples).⁴⁷ Here we have a drunken individual who is unable to count countable objects that are at some distance away, i.e. at ceiling height. For a sober individual counting the objects correctly would be easy, but for the person who is “more” than very drunk counting becomes impossible. Ch. 20 can be understood in much the same way: certain unspecified objects at a distance cannot be counted by someone who is moving in the direction of blind drunkenness. It might be objected that this defense of ἀριθμεῖν overlooks the fact that the two texts are so similar in wording that one is all but compelled either to make changes that remove the differences in wording or to posit a common source from which one of the two texts deviates. If there is real compulsion here, my choice is to select the latter alternative and to locate the deviation in ch. 9. The compiler who added ch. 9 to *Pr.* 3 recognized that the verb ἀριθμεῖν invites the question, “Count what?” Since his source provided no answer beyond “things far away,” the compiler choose to dodge the question by changing ἀριθμεῖν to ἄθρεῖν, which is compatible with counting but more inclusive. The reader would not be moved to ask himself, “Count what?” and would happily move on to what follows: namely, the assertion that failure to perceive is for some people a sign of drunkenness (872a20–21). That is, of course, no more than speculation, which should not lead us to emend the transmitted text. It is better to print both texts as transmitted (872a19–20 and 874a6–7) and to print proposed emendations in the critical apparatus.

There are other chapters in *Pr.* 3 that exhibit a close relationship to the Theophrastean *opuscula*. A clear case is ch. 33, which repeats almost verbatim

45 Bonitz (1866, 404), Klek (no reference is given, but see the critical apparatus to 874a6 in Ruelle et al. 1922, 40), and Flashar (1962, 42, 448).

46 It might be argued that if one is already very drunk, getting still drunker is not possible. Observation refutes the argument. Being very drunk is not yet blind drunk.

47 This refers to the Greek text in Fortenbaugh et al. (2003). The “they” in “they say” refers to people generally.

the question from which ch. 11 takes its start;⁴⁸ and the subsequent answer begins in much the same way as that in ch. 11.⁴⁹ But ch. 33 is half again longer (16 plus lines versus 10 plus), is clear where ch. 11 is less so,⁵⁰ and most importantly goes on to introduce Theophrastean material that is missing in ch. 11. For those reasons, I shall ignore ch. 11 in what follows.

Ch. 33 begins with διὰ τῶν: “Why are those who are drunk unable to have sex?” Two answers follow, each introduced by a formulaic question.⁵¹ The first begins ἢ ὅτι: “Is it that a certain region of the body must be heated more than the rest, but this is impossible on account of the considerable quantity of heat? So the heat arising from the movement [involved in sexual intercourse] is extinguished by the surrounding heat.”⁵² The second answer begins ἢ διότι, “Or is it because [to have sex] the lower regions must be heated, but wine naturally travels upward so that it produces heat there and takes it away from below?” (875b39–876a5). In what follows the focus shifts from the heavy drinker to other matters involving sex. Two are introduced by καί. First we are told that people are not inclined to have sex after having eaten a meal. A large breakfast and a light dinner are recommended, and a physiological explanation is added. Second, we are told that people/men who are fatigued experience nocturnal emission, for fatigue is moist and hot, so that residue forms in this region (i.e., in the groin) and nocturnal emission occurs (876a5–10). After that we are told, “For the same reason, [emission] happens in certain cases of illness, and it happens in the same way to those who are frightened and those who are dying” (876a11–14).⁵³ That ends ch. 33.

The reference to nocturnal emission resulting from fatigue has a clear connection with Theophrastus’ *opusculum On Fatigue*, in which ch. 16⁵⁴ begins in a formulaic manner similar to that found in the *Problems*. First comes a question

48 There is a reversal of word order (two words change places) and a single word (the verb “to be”) is added (cf. 11.872b15 and 33.875b39).

49 The formulaic beginning is identical as are the words that make up the opening sentence. There is only variation in word order (cf. 11.872b15–17 and 33.875b39–40).

50 See Flashar (1962, 444).

51 On the use of questions having the force of tentative assertions, see above, Section 2, p. 103.

52 The idea involved here has already attracted our attention in earlier remarks concerning chs. 5 and 26 (871a37–38 and 875a7–8), above, Section 3, p. 106, with n. 27.

53 In regard to the phrase ὅσοις γίνεται (876a12), the above translation departs from that of Mayhew and agrees with that of Forster and Flashar. The phrase limits the reference to diseases: not all illnesses but certain illnesses. Citing *Pr.* 5.31.884a6, Forster refers to φθίσις (consumption). Cf. Flashar (1962, 481).

54 For the Greek text, see Fortenbaugh et al. (2003, 274–76 ll. 123–32).

beginning with διότι: “Why are fatigued persons given to nocturnal emissions?” After that the answer is introduced by ὅτι: “Because their bodies are warm and moist on account of colliquescence, and such a condition is given to producing seed/sperm. [Fatigued persons] lie on their back on account of exhaustion. For this position is especially uneven and contributes to nocturnal emission.”⁵⁵ We would like to know what it is about lying on one’s back that contributes to emission, but no explanation is given. Instead, Theophrastus goes on to speak of sleep, digestion, residue, heat and warmth. He says, “It happens that [exhausted individuals] sleep⁵⁶ more and digest an equal amount of food less,” and then develops this contrast, beginning with less digestion. He acknowledges that sleep promotes digestion, but explains that in the case of fatigued individuals increased residue (fluid caused by stress)⁵⁷ becomes mixed with nourishment, and that hinders digestion. After that Theophrastus returns to sleeping more and explains that the increase in moisture and heat promotes sleep just as in those who are drunk. Although not stated explicitly, we understand that the body responds by way of nocturnal emission.

From this brief summary of *On Fatigue* 16, it is clear that *Pr.* 3.33 (876a9–11) is in agreement with the Theophrastean text. To be sure, *On Fatigue* 16 is longer and a self-contained chapter, but both texts recognize that the tie between fatigue and nocturnal emission depends upon increased heat and moisture. That said, it should be recognized that *Pr.* 3.33 goes on to compare persons who are fatigued with persons who suffer from certain illnesses as well as with persons who are frightened and those who are dying. For the same reason and in the same way these persons are said to experience emission. That is not found in *On Fatigue*. The author of *Pr.* 3.33 has added something, perhaps drawing on a source that combined Theophrastean material with that from other sources.

55 There are four chapters in *On Fatigue* that begin in a formulaic manner similar to that found in the *Problems*. In addition to ch. 16, there are chs. 10, 11 and 15. Of these four, three begin with διότι (10, 15, 16) and one begins with διὰ τί (11). Three begin their answer with ὅτι (10, 11, 16) and one with ἦ ὅτι (15). In ch. 16, γάρ (“for”) does not introduce an alternative answer to that introduced by ὅτι. Rather it continues and elucidates the preceding sentence, which has mentioned lying on one’s back. This position is not to be construed as a second answer that competes with warmth and moisture. Rather, it adds to what has already been said. In Photius’ excerpt of *On Fatigue* 16, γάρ is replaced by δέ (“and”) (*Library* 527b4–8, Budé edition vol. 8 p. 163.24–28 Henry).

56 Sollenberger translates “sleep in these positions.” I prefer to omit “in these positions.” It is not present in the Greek and might be thought to complicate unnecessarily what is a simple contrast: sleeping more and concocting less, καθεύδειν μάλλον—ἥττον πέττειν.

57 Cf. *On Fatigue* 3–4.

There are other references to nocturnal emission elsewhere in the *Problems*. For example, in *Pr.* 4, which carries the heading “Those [Problems] Which Concern Sexual Intercourse”, ch. 5 begins with διὰ τῷ: “Why is being barefoot not conducive to sexual intercourse?” A single answer is given, beginning with ἢ ὅτι: “Is it that the body that is going to have sex must be warm and moist within?” In what follows, we are told that the requisite condition for emission is more common during sleep than when one is awake. For this reason, nocturnal emissions occur quickly and without effort during sleep, but for persons who are awake emission occurs with labor (877a5–9). Here as in *Pr.* 3.33 and in Theophrastus’ *On Fatigue*, the involvement of warmth and moisture in nocturnal emission is stated clearly, though there is no explicit reference to fatigue.⁵⁸

Book 5 of the *Problems* carries the heading “Those [Problems] Which Arise from Fatigue.” Not surprisingly this book contains a discussion of fatigue and nocturnal emission. I am thinking of Chapter 31, which is unlike Chapter 33 of Book 3 in that the focus of the chapter is from beginning to end on nocturnal emission. It begins with διὰ τῷ: “Why are those who are fatigued and those who are consumptive prone to nocturnal emissions?” It introduces the answer with the formulaic ἢ ὅτι: “Is it that those who are hot and moist are on the whole prone to having nocturnal emissions?” (884a6–7) It ends with the recognition that persons who are fatigued or consumptive are full of warm colliquation, and along the way it states that the heat involved in sleep helps trigger nocturnal emission.⁵⁹ That is not stated explicitly in Book 3. Also new is naming a particular illness, φθίσις or consumption. In *On Fatigue* 16, Theophrastus recognizes that the bodies of fatigued individuals are warm and moist on account

58 *Pr.* 4.7 does not make explicit reference to nocturnal emission, but the chapter is of interest, for like ch. 5, it does make clear the importance of heat in causing emission. The chapter begins with διὰ τῷ: “Why is it that although sexual intercourse occurs on account of heat, and fright and dying produce cooling, [nevertheless] it happens to some people in these conditions (ἐν τούτοις τοῖς πάθεσι—see above n. 36) that seed issues forth?” A single answer is given, beginning with ἢ ὅτι: “Is it that when some places [in the body] are cooling others heat up, because they possess their proper heat and are receiving the heat of the places that are cooling down; hence, as these places cool down, [emission] happens not on account of the cooling, however, but on account of the heating?” (877a23–29). In what follows, we are told that this is clear from observation. Reference is made to defecation and urination caused by fright, and heat is said to move down in fright and upward in death. The heat causes moisture and makes seed issue forth.

59 I use the phrase “helps trigger emission” to capture the idea found in the Greek words ὅταν ἢ ἀπὸ τοῦ ὕπνου θερμότης προσγένηται (884a9–10). On account of stress, the body of the fatigued person is already moist and warm. When the heat from sleep is added (προσ-) emission occurs.

of colliquescence and that moisture and warmth promote sleep, but we are not told that the heat from sleep can be the additional factor that triggers nocturnal emission. We can say, then, that the discussion of *Pr.* 5.31 is in line with *On Fatigue* 16, but like *Pr.* 3.33 it contains details from elsewhere.

There is also *Pr.* 10.16. Book 10 carries the heading “Epitome of Physical Problems” and the chapter begins with διὰ τῶν: “Why do some of the other animals (i.e. animals other than human beings) not have nocturnal emissions and others rarely?” Two answers follow introduced in formulaic manner. First comes πότερον ὅτι: “Is it that none lies down on its back, and none has an emission except on its back.” Here for the first time in the *Problems* we have explicit reference to lying on the back. But the answer is puzzling, for it implies that no animal experiences nocturnal emission, while the question indicates that at least some do if only rarely.⁶⁰ Second comes ἢ ὅτι: “Or is it because the other animals do not dream in the same way; but nocturnal emission occurs with imagination?” (892b15–18). New is the verb ἐνυπνιάζειν, “to dream” (892b17). To be sure, the idea of dreaming is present in the verb ἐξονειρώττειν, which is found in 3.33 (876a9, 11) and in the adjective ἐξονειρωτικός, which occurs in 5.31 (884a6, 7).⁶¹ The verb is found also in the question that introduces 10.16 and in the first answer (892b15, 16).⁶² Nevertheless, the verb ἐνυπνιάζειν is not found either in *On Fatigue* 16 or in the other chapters of the *Problems* dealing with nocturnal emission. More importantly, the occurrence of ἐνυπνιάζειν in 10.16 may be said to prepare the way for the introduction of imagination, φαντασία. We are told that nocturnal emission occurs together with imagination (892b18). Mayhew adds “always” in parentheses, which is understandable. For the *Problems* is a Peripatetic work, and the involvement of imagination in dreaming is Peripatetic doctrine. See, e.g., Aristotle, *On Soul* 3.3.428a8, *On Dreams* 1.458a33–459a22. We would like to have been told exactly what is meant by the statement that “the other animals do not dream in the same way,” ὁμοίως (892b18), but no clarification is provided.⁶³ In *Research on*

60 For a different case of an apparently wrongheaded answer, see above, Section 2 on 3.25b.

61 After Homer the nouns ἐνύπνιον and δνειρος are used interchangeably (LSJ s.v. ἐνύπνιον 2).

62 In 10.16 we also have the noun ἐξονειρωγμός (892b18). In 5.31 ἐξονειρωτικός occurs (884a6, 7.).

63 My guess is that the answer depends upon the recognition of two kinds of imagination: sensory imagination, which Aristotle attributes to animals, and deliberative imagination, which he attributes to human beings. Lacking deliberative imagination, animals do not hold beliefs, which result from inference, and do not engage in calculation. In contrast, human beings hold beliefs and engage in deliberation. And their dreams are correspondingly richer than those of animals. In their dreams, humans imagine, e.g., that a loud noise means danger; they believe that they are threatened and begin to deliberate how

Animals 4.10, Aristotle says that all viviparous quadrupeds dream, but it is not clear whether ovipara do (536b24–32). Apparently there are differences between animals, and these differences reflect a difference in imagination. In *On Soul* 3.3 Aristotle says that ants and bees possess imagination but the grub does not (428a10–11). That tells us that the grub does not dream and does not experience nocturnal emission. That ants and bees dream and experience emission is not stated. The possibility is there, but we should keep in mind that nocturnal emission depends on several factors including heat and moisture.

There is still another passage in the *Problems* that should be mentioned. It is found in Book 33, whose heading is “Those [Problems] Which Concern the Nostril.” There Chapter 15 begins with διὰ τῷ: “Why does sneezing alone not happen to us when we are asleep, but virtually always when we are awake?” The answer begins with ἢ ὅτι: “Is it that sneezing occurs due to some heat moving that region from which it comes—and this is why we lift up our heads to the sun when we want to sneeze—whereas when we are asleep the heat is compressed within?” (963a5–10)⁶⁴ In what follows, nocturnal emission is mentioned as an example of what occurs when heat is compressed within during sleep. It combines with the breath that moves downward, so that emission occurs (963a10–12). New here is the emphasis on breath (the quantity of breath is said to be the cause, αἴτιον, of our experiencing nocturnal emissions), but it is also clear that heat is an important factor as it is in 3.33 and 4.7. The chapter continues with a discussion of passing wind during sleep. Heat and breath are again fundamental to the discussion; fatigue is mentioned neither here nor in the earlier portion of the chapter.

From the above, it should be clear that the several chapters in the *Problems* that refer to nocturnal emission differ in the ways in which they relate to what Theophrastus says in *On Fatigue*. Flashar makes the point with special reference to 5.31 and 10.16, when he tells us that the ideas found in the Theophrastean *opusculum* are divided among these chapters.⁶⁵ That is correct: 5.31 emphasizes the importance of heat and moisture, while 10.16 takes note of lying on one’s back. Flashar adds that this division constitutes an unequivocal proof of

safety may be achieved. Such a dream is impossible for an animal. See Fortenbaugh (2002, 95–96, 102–103).

64 *Supplementa problematorum* 2.40 p. 140.10–142.4 Kapetananki-Sharples repeats with only minor variation what we read in *Problems* 33.15.963a5–10. But the *Supplementa* cuts off before coming to nocturnal emission and passing wind during sleep, which are taken up in the continuation of *Problems* 33.15.963a10–32.

65 Flashar (1962, 514).

the priority of *On Fatigue*. “Unequivocal” is perhaps a tad bold,⁶⁶ but I agree with Flashar concerning the priority of the *opusculum*. I add only that accepting the priority of *On Fatigue* does not establish how the Theophrastean material came to be present in the several chapters of the *Problems*. The material may have found its way through different intermediaries and different compilers at different times. And these compilers will have added material that is not Theophrastean or at least not found in *On Fatigue*. I am thinking especially of references to animals that are said to experience emission and to emotion and disease as causes of emission.⁶⁷

5 Just as, In the Same Way, Not in the Same Way

I want to close this essay with a brief look at several chapters in *Pr.* 3, in which the words ὡσπερ (“just as”), ὡσαύτως (“in the same way”), and μὴ ὡσαύτως (“not in the same way”) play a prominent role. The authors of the *Problems* were understandably interested in similarity and sameness, for it might provide the best way to resolve a particular problem. Indeed, given the limitations that confronted them in physiological investigation, similarity and sameness might provide the only plausible answer to a difficult problem.⁶⁸

I begin with *Pr.* 3.16, in which ὡσπερ occurs four times. The question that introduces the chapter is, “Why does wine make people both stupefied and

66 Since Flashar has already (only a few lines earlier on p. 514) referred to 3.33, 4.5, and 33.15, as well as 5.31 and 10.16, he may want the reader to understand that all five texts support the priority of *On Fatigue*.

67 The emphasis on breath in 33.15 not found in *On Fatigue*, but given Peripatetic interest in πνεῦμα, it seems likely that in another context Theophrastus did consider the role of breath in causing nocturnal emission. The same hold for imagination, which is mentioned in 10.16.

68 Cf. Anonymous, *On Aristotle's Posterior Analytics* 2.15.98a24 (CAG vol. 12.3 p. 590.4–10 Wallies = Theophrastus, fr. 136 FHS&G): “By means of these remarks, [Aristotle] teaches us how we may recognize those problems which are the same as one another, although they seem not to be because they are formulated with different subject matter, so that if we are provided with an explanation about one of them, we are able to speak in a similar way about the others. Theophrastus, too, busied himself about the collection of problems which are similar. But he is enquiring in those [works] about which of the problems are similar to one another; Aristotle, on the other hand, is here teaching about how we may decide problems which are the same as one another.” The distinction drawn between the two Peripatetics strikes me as unlikely unless limited to a particular Theophrastean work or works.

frenzied, τετυφωμένους ποιεῖ καὶ μανικούς?” There follows intermediate material that clarifies the question: “For these dispositions are opposite: for the latter actually involves more movement, and the former less.”⁶⁹ After that begins the answer: “Is it just as (ὥσπερ) Chaeremon said, ‘[Wine] is mixed with the characters of the users’ (τῶν χρωμένων γὰρ τοῖς τρόποις κεράννυται)?” (873a23–26). Here ὥσπερ introduces a line of iambic trimeter from a tragedy of Chaeremon (fr. 16 Nauck² p. 787 = *TrGF* 71F16).⁷⁰ Naming Chaeremon adds a scholarly touch, but it does more: it gains the reader’s attention, for Chaeremon was a respected poet, who might be expected to present truth in an effective manner.⁷¹ Be that as it may, there follows a general statement indicating the relevance of Chaeremon’s verse to the question under discussion: “Therefore, [wine] produces opposite results not with respect to the same things, but to things that are not similar” (873a26–27). What is not immediately clear is whether the characters, τρόποι, of the users referred to by Chaeremon are to be understood as physiologically determined dispositions, or as acquired characters or both.⁷² Chaeremon will not have asked himself this question and might have dismissed it as sophistic φλυαρία. But in the context of *Problems* 3.16, I am inclined to opt for the first alternative: namely, physiological dispositions, for

69 The intermediate material might be regarded as part of the question. The distinction is of no importance.

70 The verse of Chaeremon is found also in Athenaeus 13.14.562E. In the Loeb translation Gulick treats the dative τοῖς τρόποις as a dative of advantage or more generally a dative of reference. He translates, “Just as wine is mixed to suit the character of the drinkers.” That is possible but in my judgment unlikely to be correct. Since I have discussed the Athenian passage at some length in my commentary to Theophrastus’ ethics (2011, 672–77), I refer the reader to that discussion. (Theophrastus is named immediately before the reference to Chaeremon in fr. 559 FHS&G).

71 Chaeremon’s finished style was recognized by Aristotle (*Rhetoric* 3.12.1413b13).

72 While acquired character like moral virtue and vice is frequently opposed to innate temperament like intensity and impetuosity, we should keep in mind that acquired character includes much more than virtue and vice, which are learned in the family and in school. We should also keep in mind that physiologically determined dispositions may manifest themselves not only in overt bodily behavior but also in a person’s thoughts. Moods like depression and cheerfulness often have a physiological basis. They may affect how a person sees the world and the judgments he makes. Yet no particular thought is the cause. Ask a cheerful person why he is cheerful and he may be unable to answer, for there is no reason beside his physiological state. The same holds for despondency in general and the crabbedness of old age. Hence Plato in the *Laws* recognizes wine as a gift of the god Dionysius. Through it the hard cast of an old man’s mind becomes softer and more malleable, like iron in a fire (2.666B–C).

the opening question, with its reference to stupefied and manic persons, suggests that dispositions rooted in a bodily condition are the focus of the chapter.

This impression is strengthened by the comparison that is introduced by the second occurrence of ὥσπερ. It is an example taken from the physical world: “*Just as* fire dries some things and makes others moist, but not the same things: it melts ice and solidifies salt” (873a27–29). We are then told that wine tightens and quickens the slow and relaxes the quick. Wherefore some of those who are melancholic by nature, τῇ φύσει, become completely relaxed during drinking bouts. The physiology behind this contrast is at best vague, but we may compare *Pr.* 30.1, where we are told that the melancholic humor, i.e., the black bile present in human beings, is a mixture of hot and cold. When the cold predominates, an individual is naturally sluggish and spiritless; when heat predominates, he is easily moved and high-spirited (954a11–955a40). Applied to *Pr.* 3.16, we can say that wine is able to work a cooling effect on the person who is easily moved (the heat of wine extinguishes the natural heat of such a person; cf. 30.1.954b39) and to increase the temperature of someone who is naturally lethargic (heat around the region in which one thinks, i.e., in the region around the heart, can make a person more hopeful and cheerful; cf. 30.1.954b39–955a1). Whatever the merit of such a physiological explanation, the notion of opposed effects is clear and reinforced by a new example introduced by the third and fourth occurrences of ὥσπερ: “For *just as* a bath makes those who are stiff in body and hard able to move more easily, while it relaxes those who move easily and are moist, so wine, *just as* bathing the inside, accomplishes the same thing” (873a33–36).⁷³ The comparison with bathing is analogical involving four terms: as (1) bathing relates to (2) the mobility of the body, so (3) drinking wine relates to (4) a person’s physiologically determined character. In both cases a qualitative change is effected. And in both cases opposite changes are possible, because the second and fourth terms admit opposition.⁷⁴ The second term covers bodies that are hard to move and easy to move, while the fourth term covers dispositions that are quick and slow.⁷⁵

73 I have translated the fourth occurrence of ὥσπερ with “just as” in order to be consistent. Mayhew prefers “as if”. The difference is minor, but I have maintained the same translation in order to underline that a single line of argument is being maintained.

74 Both are determinable as against determinate.

75 While it is natural to use adjectives like “quick” and “slow” to describe physiologically determined character, we should remind ourselves that in human beings physiology has an effect on thought. In *Pr.* 30.1, we are told that heat around the region in which we think makes us cheerful and much wine produces good hopes in everyone (954b39–955a3). Feelings of warmth may be part of cheerfulness, but in human beings cheerfulness is also

Turning now to *ὡσαύτως* (“in the same way”), I refer to *Pr.* 3.33, which has already received attention above in Section 4. The chapter begins with the question, “Why are those who are drunk unable to have sex?” Initially the author stays focused on the question, pointing out that having sex requires heat in the lower region of the body, but in drunks the heat is either extinguished or travels upwards. After that the author’s attention shifts and we are told that heat travels upward to the stomach after eating and that nocturnal emission occurs in fatigued persons because they become warm and moist and residue collects in the lower region. A final remark tells us that “what happens to them [i.e. persons experiencing nocturnal emission] also happens for the same reason to those who are ill, and in the same way (*ὡσαύτως*) in those who are frightened and those who are dying” (876a11–14). Here there are four groups of people, who are so described that they are readily understood to be distinct groups. One group is said to be fatigued, asleep and apparently healthy; another group is ill; still another is experiencing the emotion of fright; and a last group is said to be dying. The emotion of fright is essentially cognitive: it is caused by the belief that danger is imminent. In contrast, sickness (think of consumption, 5.31.884a6–7) has no essential tie to cognition. Rather, the root cause is bodily. A dying individual might be unconscious, but that is not the same as being a healthy person who is fatigued and asleep. Given such differences, is it correct to say that emission occurs *ὡσαύτως*, in the same way?

From one point of view, an affirmative answer is correct. For it is made clear that in all four cases the proximate cause is a combination of warmth, moisture and residue in the lower region (876a10–11). But a fuller and more satisfactory way of describing these four cases is suggested by ch. 26, already introduced above in Sections 2 and 3. The question posed is: “Why do drunkards tremble, and the more so according to how much unmixed wine they drink?” (874b22–23). The question is a serious one, for wine is said to be hot and the cause of trembling is cold. We understand that the person who is exposed to a cold wind becomes chilled and as a result trembles (874b24–25). But the drunken individual, who is not exposed to a cold wind, is apt to experience trembling after consuming much wine, which is hot. The problem is resolved by recognizing that opposites may have the same effect, but not acting in the same way, *μὴ ὡσαύτως δὲ ποιούντων* (874b36–37).⁷⁶ Whereas a cold

cognitive. We believe that the moment is good and our hopes for the future are positive. See above n. 71 on temperament and moods.

76 In ch. 26 the idea is formulated as a question, being a tentative response to the question that begins the chapter. In context the question has the force of a modest assertion. See above, Section 2 p. 103.

wind causes trembling by direct/immediate contact with the body,⁷⁷ wine works a cooling effect in quite a different way. As drinking proceeds and the heat of wine increases, it extinguishes or weakens the heat proper to the body, so that trembling occurs. As already observed, the idea is Peripatetic doctrine: the greater fire consumes the smaller.⁷⁸ We may find the doctrine odd, but in regard to drinking and trembling it serves a useful purpose. The phenomena can be saved and a single cause identified: both persons exposed to a chilling wind and persons who drink heavily experience trembling. And in both cases the cause is cooling. Only in the case of heavy drinking there is an intermediate step that results in cooling: the heat proper to the body is extinguished by the heat of the wine.

Returning now to *Pr.* 3.33, we can say that the phenomena are saved as well as a single explanation. The proximate cause of nocturnal emission is the moist and the hot (876a9–14). That is not puzzling in regard to persons who are fatigued, for stress has created a warm and moist condition. The same holds for persons who are sick with e.g. consumption. Their bodies are warm and moist owing to the discharge coming from inflammation (5.31.884a14–15). Fright and death are apparent exceptions, for both are marked by cooling. Only in both cases the process of cooling creates heat in the requisite region of the body. When a man becomes frightened, cooling occurs above and heat moves downward; when a person is dying, cooling begins below in the extremities, so that heat moves upward (4.7.877a23–34). In both cases, the resulting condition is suitable for emission. Whether there is any truth in all of this may be left aside. I prefer to end by saluting the authors of the *Problems* for ingenuity in saving the phenomena.⁷⁹

77 Or simply the cold air of winter with or without wind (3.5.871a34–35).

78 See above, Section 3, p. 106 with n. 26.

79 My salute is qualified by the fact that I have never heard of anyone who became frightened and for that reason emitted seed, let alone did so at night while asleep. Fright can cause a bowel movement (4.7.877a32), and it can cause urination. Athletes who engage in single combat can attest to the latter, but that is different from ejaculation. Or should we associate fright with dying and think of execution by hanging. A load in the pants is said to be common. Is there also erection and ejaculation? I need a urologist or an executioner for an authoritative report, as well as a student of ancient medicine.

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Material and Teleological Explanations in *Problemata* 10

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1 Introduction

It is now generally agreed that Aristotle did not write the *Problemata* as this work appears in the *corpus Aristotelicum*.¹ For instance, W.S. Hett (1936, vii) reports that “[t]here can be no doubt that Aristotle is not the author of the *Problems* as they have come down to us; he is, however, known to have written a book of Problems of which parts have clearly been incorporated in the present work.” On this view, the *Problemata* is likely a compilation of chapters written by different authors. Some of the chapters might be by Aristotle himself, but most are likely written by Peripatetic philosophers following Aristotle.² In short, the idea is that the *Problemata* is Aristotelian, though not written by Aristotle by himself.

In this chapter I analyze the content of *Pr.* 10 with the goal of defending a strong version of the prevailing view:³ not only are the chapters included in *Pr.* 10 written by Peripatetic philosophers, but by philosophers who are Aristotelian in the robust sense that they accept Aristotle’s natural teleology and the explanations of natural phenomena in some chapters are so close to what we find in Aristotle’s biological works that these chapters could be written by Aristotle himself.⁴ The content of Book 10 presents two challenges to

1 See Forster (1928), Hett (1936), and Mayhew (2011).

2 See Hett (1936, vii) and Mayhew (2011, xvi–xviii).

3 The weaker version of the prevailing view is, to my mind, less interesting though it is consistent with the suggestion that the *Problemata* started with problems from Aristotle where some of Aristotle’s problems were later removed and other problems were added by other Peripatetic philosophers. For this, see Louis (1991, xxv–xxx). To say only that the authors are Peripatetic in the broad sense of being members of Aristotle’s school tells us very little about the authors’ philosophical views. Theophrastus and Strato, who succeeded Aristotle as heads of the Lyceum, seem to have denied aspects of his natural teleology. According to Plutarch, Strato even denied the involvement of purpose (and, thus, final causes of the sort Aristotle identifies) in nature. On this point, see Sharples (1999).

4 My focus is on the content only. A complete analysis would involve the complementary analysis of the language used in *Pr.* 10. My view can be contrasted with Louis’ (1991, 149–55). He

this view. First, many of its chapters include ideas and claims that are inconsistent with the ideas and claims we find in Aristotle's biological works.⁵ Second, nearly all of the explanations in *Pr.* 10 are material explanations.⁶ The second challenge is more significant than the first. If the authors of *Pr.* 10 accepted Aristotle's natural teleology, we would expect explanations of natural phenomena that focus on final, rather than material causes: we would expect to find teleological explanations of the kind we find in Aristotle's work.⁷ Yet very little in this book makes Aristotelian teleology conspicuous.

Despite these challenges, I argue that the content of *Pr.* 10 is Aristotelian by establishing that the *kind* of questions and answers we find in it are consistent with what we find in Aristotle's own works. *Pr.* 10 fits into the framework of Aristotle's natural teleology even if the chapters of this book lack any explicit teleological focus.

2 *Pr.* 10 as Ἐπιτομή φυσικῶν

The title of *Pr.* 10, Ἐπιτομή φυσικῶν, suggests that this book is an epitome—a summary or abridgment—of problems related to nature.⁸ The problems considered in Book 10 reflect only a small subset of the natural phenomena

claims that *Pr.* 10 could not have been written by Aristotle. I agree only to the extent that, if *Pr.* 10 were written by a single author, it certainly wasn't Aristotle.

- 5 These include *Historia animalium* (all translations by Peck, 1965), *De partibus animalium* (all translations by Lennox, 2001b), *De motu animalium*, *De incessu animalium* (all translations by Farquarson, 1912), *De generatione animalium* (all translations by Peck, 1943). I follow Gotthelf (see 2012, 311) and Balme (1961) in thinking that the purpose of *HA* is to catalogue differences in the features of animals that are to be explained "later" (cf. *HA* 1.6.491a7–11)—i.e. in the other biological works. Certainly, Aristotle does not say much about the causes of differences in animals in his *historia*.
- 6 Cadden (2006, 13) reports that the lack of teleology was one reason medieval instructors were attracted to the *Problemata*: "Other Aristotelian works . . . offered comparable opportunities" to study the science of nature. "But, the *Problemata* . . . was especially free from the imperatives of teleology." As such, "the text attracted intellectuals for whom the investigation of proximate efficient and material factors was the primary concern."
- 7 Recent insights about Aristotle's natural teleology successfully highlight the extent to which Aristotle himself focuses on teleological explanations. See, especially, Johnson (2005), Leunissen (2010), and Gotthelf (2012). Gotthelf's book includes updated versions of his most influential articles in this area.
- 8 Mayhew (2011, 279) asks "Of what is *Pr.* 10 an epitome (i.e., a summary or abridgement)?" He notices that *Pr.* 10 is not plausibly read as a summary or abridgment of the other books of the *Problemata*. Many of these focus on problems related to living things (*Pr.* 1–11, 22–23), the parts of humans (*Pr.* 31–38) and meteorology (*Pr.* 27–30).

Aristotle sets out to explain. Thus, *Pr.* 10 is certainly not an epitome representing Aristotle's complete science of nature.⁹ It is not even a summary of Aristotle's study of animals in so far as we find many more phenomena being identified and explained in Aristotle's treatises on animals than we find in *Pr.* 10.¹⁰

Book 10 consists of sixty-seven chapters concerning problems related to the study of animals and focusing, mostly, on human animals. Each chapter starts with a 'why' (διὰ τί) question,¹¹ calling for an explanation of some observable phenomenon or phenomena, and includes possible answers. Nothing indicates that the answers provided are meant to be exhaustive or final in any way. Nearly all of the answers are presented in the form of a further question or questions. Frequently, more than one answer or explanation is suggested without any indication even of whether the answers are meant to be complementary—i.e. different aspects of a complete explanation—or in competition.

The range of topics addressed in this book is broad and apparently random. Nothing obvious unifies the consideration of why some but not all animals cough (*Pr.* 10.1), of the amount of milk produced by goats and sheep (10.6), of the relative size of males and females (10.8), of the occurrence of blue eyes in some humans and horses (10.11), of the occurrence of nocturnal emissions (10.16), of the amount of time animals sleep (10.31), of the occurrence of belching and breaking wind (10.44), of longevity of life (10.49), or of the lack of baldness among eunuchs (10.57), for example.

9 The study of plants and the study of animals are parts of the science of nature and, as Leunissen (2010) makes clear, Aristotle's study of natural science includes also the study of the heavenly bodies.

10 To settle whether *Pr.* 10 should properly be considered an *epitome* of Aristotle's work and what exactly this means goes well beyond the purpose of this chapter. For this project, it is enough to note that my observations do not challenge the classification of *Pr.* 10 as an epitome in so far as an epitome need not be a complete summary or even an abridgment of ideas in their original formulation. See Zucker (2012), which considers two zoological works identified as *ἐπιτομή*. One is the work attributed to Aristophanes of Byzantine and referred to as the *epitome* of the natures of fish. See, for instance, John the Lydian's *De Magistratibus Republica Romanae* where the Lydian refers to an idea expressed by "Ἀριστοφάνης δὲ ὁ Βυζάντιος ἐν τῇ Ἐπιτομῇ τῶν ἐν ἰχθύσι Φυσικῶν" (Bandy, 1982, 232). As Zucker reports, Aristophanes' work was based on the works of Aristotle and is presented as an *epitome* though it includes only some of the ideas from Aristotle's zoological treatises and reflects the revisions of Peripatetic philosophers.

11 In this way *Pr.* 10 is consistent with the chapters in the other books of the *Problemata*—Mayhew (2011, xiii) reports that 98% of all chapters begin with διὰ τί. In Book 10, chapter 12 is an exception in so far as it starts with a variation: Διὰ τίνα αἰτίαν (892a6).

There are no overarching themes evident in the vast range of phenomena considered in *Pr.* 10. There are, however, some phenomena that are the topic of concern in multiple chapters. Sixteen of the sixty-seven chapters in *Pr.* 10 focus on, or include comments about, variations in hair. Four chapters have eunuchs as their focus. Even in these cases, however, there is no overarching organization of the chapters. Considerations of the features of eunuchs, for instance, are found in chapters 36, 37, 42, and 57 with no obvious reason why they aren't presented one after the other.¹² For the most part, each of the chapters is independent from the others and there is no grouping of chapters according to their focus.¹³

Robert Mayhew (2011, 279) suggests that “[f]or nearly half of the sixty-seven chapters, possible or probable sources can be identified from Aristotle’s biology.”¹⁴ This indicates the possibility that some of the individual chapters in Book 10 are supposed to capture, in summary form, Aristotle’s explanation of the phenomenon in question. Certainly it is plausible to read some chapters as summaries of this kind. Consider, for instance, *Pr.* 10.26 which concerns one question for which Aristotle attempts to provide an answer in his biological works: “Why do all animals have an even number of feet?” The explanation in the *Problemata* appeals to the necessity of having sets of two (or pairs) of feet in order to move: “it is not possible to move if one part is not standing still, unless one jumps” (893b20–22).¹⁵

12 In a few places, we find subsequent chapters concerned with the same general questions or topic, but these do not reflect any deliberate editorial strategy. Chapters 21–25, for example, are all concerned with problems related to variations in hair, while other chapters concerned with variations in hair are scattered throughout the rest of *Pr.* 10.

13 There are a few exceptions. *Pr.* 10.23 includes an explicit appeal to the explanation presented in chapter 22 (see 893a38); 10.39 seems to address the questions posed, but not answered, in 10.38; and, 10.48 and 49 are both concerned with the longevity of life. Mayhew (2011) notes that chapter 48 ends with a call to consider factors that are the focus of chapter 49. None of the other chapters are so obviously related to each other.

14 Mayhew (2011) includes a series of notes pointing to possible or probable sources of the various questions. These notes are a welcome addition to the translations and inform my study of the text though in many cases my analysis challenges the suggestion that the specific ideas in *Pr.* 10 find their source in Aristotle’s works.

15 *Pr.* 10.30 considers the same question as 10.26. Though the chapters are not identical, the answers are consistent. Whereas the claim that having an even number of feet is necessary for walking is explicit in ch. 26, this detail is only implicit in ch. 30. Both chapters, however, make clear that one foot (of each pair) must be at rest while the other foot (of each pair) is moving in order for the animal to move. I am setting aside, for now, the question concerning the relation between 10.26 and 10.30 and the implications regarding the

In the first chapter of *De incesso animalium* Aristotle announces that we must consider, among other things, “why all [animals] have an even number of feet if they have feet at all; why the points on which progression depends are even in number” (*IA* 1.704a14). He takes up the question again in the eighth chapter. Just as we find in *Pr.* 10.26,¹⁶ Aristotle notes the exception of jumping (the explanation of which does not require even numbers of feet) before explaining the necessity of having pairs of feet for walking. Despite the explanation in *IA* 8 being more involved than the one in *Pr.* 10 (the former runs for more than one complete Bekker column, while 10.26 runs less than five Bekker lines), the explanations in both works have the same two components: The first is the assertion that it is necessary¹⁷ to have an even number, or pairs of, feet for walking or running. The second is the mechanistic account of why this is necessary—one point of motion must be at rest while the other moves. Both the question and the answer set out in *Pr.* 10.26 matches what we find in Aristotle’s biological works so well that the author of this chapter could have been Aristotle himself.¹⁸

In contrast, most chapters included in the *Problemata* contain insufficient detail to conclude anything stronger than that the explanation is *consistent with* the corresponding explanation we find in Aristotle’s works. *Pr.* 10.28 concerns why, in humans but not other animals, twins do not survive equally well when one twin is male and the other is female. This same phenomenon is considered in Aristotle’s *De generatione animalium*.¹⁹ In both texts, it is said to be “counter to nature” (*παράφύσιν*) for humans to have male-female twins. In the *Problemata*, an explanation is suggested by the following: “Is it because . . . the twins are especially weak? For the human is [normally] the bearer of one child. Now in the case of twins begetting a male and a female is contrary to nature, and so what is especially contrary to nature is also weakest” (*Pr.* 10.28.894a7–12). This explanation is woefully incomplete. The reader must supply the (perhaps plausible) assumption that what is weak tends not to survive. And, the

authorship of each. Certainly it would be odd for one author to have written both of these chapters with the intent to include both in a single book of problems.

16 *Pr.* 10.30 does not match the other passages in this respect.

17 Of course, it is not strictly necessary. Aristotle himself recognizes, for example, that injured animals can walk even after the loss of (function in) a limb. He holds, however, that these ‘mutilated’ animals do not properly walk (*IA* 8.708b10–11). Presumably, he would think they *hobble* as they compensate for the inability to walk properly.

18 Though less detailed, *Pr.* 10.30 similarly matches what we find in Aristotle’s work.

19 This phenomenon is also noted, but not explained, at *HA* 4.4.584b36–585a3.

reader must work to determine what it could mean to say that the phenomenon to be explained is “especially” contrary to nature. Mayhew (2011, 305) reads this comment to mean that “the birth of male and female twins in animals that normally bear one child” is contrary to nature. Perhaps we are to interpret this phenomenon to be contrary to nature in two ways: first, because humans usually have one child and, second, because twins are usually of the same sex. If we do, *we* are supplying details without any concrete reason to do so given the what information we find in this chapter.

A fuller explanation of this phenomenon is found in *GA* 4.6. There, Aristotle explains that male offspring and female offspring develop at different rates and to different levels of completion in humans but not in other animals. The differences are explained by what Aristotle takes to be the fact that “in human beings the male is much hotter in its nature than the female” (775a5–6). One result of this difference in natural heat is that the male embryo develops faster than the female embryo (775a17–19). What is “contrary to nature” in humans, then, is that a male and a female would “keep pace with one another” or run an equal course of development; male and female offspring “require unequal periods for this development to take place” (775a22–25). Since they are born together, male and female twins will have the same amount of time to develop and, whenever the birth of male-female twins occurs, “the male is bound to be late or the female early” or both (775a26).²⁰

There is no hint in *Pr.* 10.28 of Aristotle’s idea that, in humans but not the other animals, the difference in the natural heat of males and females is sufficient to affect the relative rates of fetal development. Since the explanation we find in *GA* 4 is more detailed than the explanation in *Pr.* 10.28 and includes details about which there is no hint in the *Problemata*, chapter 28 cannot be read as an adequate summary of the explanation we find in *De generatione animalium*.

Further undermining the possibility that specific chapters in *Pr.* 10 are intended to serve as a summary of Aristotle’s explanations of specific natural phenomena is the fact that some chapters include ideas that Aristotle explicitly rejects in his biological works. Chapter 57, for example, can be taken to imply the author’s acceptance of pangenesis—the idea that *semen* comes from all parts of the parent’s body—in so far as it is suggested that eunuchs

20 I add “or both” for the reason that the disjunction is plausibly read as inclusive—it seems possible, given Aristotle’s explanation and his insistence that the difference between the natural heat of the male and of the female human is sufficient for birth to occur too late for the male twin and too early for the female twin.

tend not to go bald for the reason that they do not associate with women and “semen moves from the brain through the spine” (897b5). It is plausible to read this comment to imply pangenesis because this idea is presented as a possibility elsewhere in the *Problemata*. Consider *Pr.* 4.18, which includes the idea that material from the buttocks and eyes become leaner “and much of [this material] is secreted into the seed” (876b16–18), and *Pr.* 4.21, where we find the author suggesting that *sperma* is “an excretion from the entire body” (879a5–9). On any obvious interpretation, these statements reflect a version of the theory of pangenesis that Aristotle explicitly rejects.²¹

In some instances, the very facts to be explained in *Pr.* 10 seem to be undermined by facts Aristotle records in his *Historia animalium*. For example, *Pr.* 10.45 concerns why “all the tame animals [are] in every case found wild as well, but all the wild animals are not in every case found tame. For even humans clearly are wild in some places” (895b23–24), while Aristotle claims in *HA* 1.1 that some animals are always tame and indicates that these include humans and mules (488a26–31).²² And *Pr.* 10.44 includes the claim that birds neither belch nor break wind (895b17–18), whereas Aristotle reports that the turtle-dove has a peculiar habit of breaking wind while moving its hind-parts rapidly (*HA* 9.49.633b5–7).²³ We might be tempted to explain away these apparent and minor inconsistencies, but the very fact that we are tempted to do so reflects that these passages pose a challenge to reading *Pr.* 10 as an epitome of parts of Aristotle’s biological works.²⁴

So much for the consideration of whether ideas presented in specific chapters of *Pr.* 10 are meant to serve as summaries of ideas having their source in Aristotle’s biological works. When we step back to consider the content of *Pr.* 10 as a whole, we have another reason to question the extent to which

21 Relying on the ideas in *Pr.* 4 to support an interpretation of *Pr.* 10 carries its own risk. This is owing to the fact that claims in the different books sometimes rub against each other. Consider, for example, that *Pr.* 4.18 suggests that *bald* people are lustful (878b22–23) whereas the problem to be addressed in both 4.31 and 10.24 concerns why *hairy* people are lustful (there is significant overlap in the content of 4.31 and 10.24). It goes beyond my project in this chapter to address apparent inconsistencies in the *Problemata* as a whole.

22 Peck (1965, 17) dismisses this comment as an interpolation.

23 In both places, what I am rendering “break wind” is a variation of ἀποψοφεῖν. The same verb is used also in *Pr.* 27.9.948b22–27 where breaking wind is reported to be one response to fear.

24 My current analysis provides no positive answer to the question concerning what *Pr.* 10 might be an epitome of. As my project is focused on an analysis of *Pr.* 10 in relation to Aristotle’s biological works, I leave the possibility that it is an epitome of some other work or collection of works for another project.

the explanations presented in it are Aristotelian in any strong sense, let alone Aristotle's own. I turn to this now.

3 A Wider Problem: The Dearth of Teleological Explanations in *Pr.* 10

While we can be confident that Aristotle was not the author of each and every chapter included in the *Problemata* as it survives in the *corpus Aristotelicum*, we might remain confident that the *Problemata* is Aristotelian in the strong sense I am arguing in so far as it reflects the *kinds* of problems to which Aristotle devoted his attention and the *kinds* of answers or explanations that Aristotle presented. This confidence is tested, however, by an initial survey of *Pr.* 10 where nearly all of the explanations are material explanations. Aristotle himself prioritized teleological explanations in the science of nature.

In *PA* 1, Aristotle outlines aspects of what we might call his *philosophy of biology*.²⁵ This book opens with the assertion that we should start by getting a hold of the phenomena concerning each animal kind before stating the causes of these phenomena.²⁶ He then announces that, though we can identify more than one cause of generation (presumably, we can identify any one of the four causes outlined in *Phys.* 2), “it is apparent that first is the one we call *for sake of which*; for this is an account, and the account is an origin . . .” (639b14–16, emphasis added). In this sense, the origin of natural generation is what *comes to be*—i.e. the mature animal—rather than what is first in time (640a1–9). “We say ‘this is for the sake of that’ whenever there appears to be some end towards which the change proceeds if nothing impedes it. So it is apparent that there is something of this sort, which is precisely what we call a nature” (641b25–26) and “nature is an origin more than matter” (642a16). Because “generation is for the sake of substantial being, rather than substantial being for the sake of generation” (640a17–18), our explanations of natural substances should focus on the nature of each substance as the final cause of each substance.

According to Allan Gotthelf's interpretation, Aristotle rejects the way in which his predecessors²⁷ reduce all causes in nature to material causes for the

25 This way of characterizing *PA* 1 is stated in the clearest terms by James G. Lennox (see, for instance, 2001a, xii and 2001b, xxi–xxiii).

26 This is, largely, Aristotle's project in *Historia animalium*, though *De partibus animalium* and *De generatione animalium* seem to bring along their own observations too.

27 Aristotle frequently singles out Empedocles or Democritus by name when taking “the ancients” to task for focusing on the material cause of each phenomenon and for failing to recognize final causes. See, for example, *PA* 1.1.640b19.

reason that Aristotle thinks the coming to be of natural substances cannot be explained without appeal to the *directedness* of nature. Explanations in nature must, then, appeal to what Gotthelf (2012, 17) calls an “irreducible potential for form” and the manner in which nature works to actualize each animal’s form through the process of generation.

In contrast to the priority given to teleological explanations in Aristotle’s work, it is striking that *Pr.* 10 includes little hint of teleology at all.²⁸ Nearly all of the explanations in Book 10 are material explanations. Consider, for instance, the explanations in the many chapters concerning variations in hair.²⁹ These include questions related to why only humans’ hair goes or grows white or grey (10.5, 27, 33, 34, and 63); why the hair of some animals changes colour (10.7); why hair is soft or hard after it is plucked (10.22); why hair grows from scar tissue on some animals but not others (10.27 and 29); and so on.

Individually and collectively, these chapters indicate that the nature of animals’ flesh and skin explains many of the variations in hair.³⁰ The way in which hair grows from deep in or at the surface of the flesh influences both whether soft or hard hair grows back after being plucked (10.22) and whether hair becomes softer or coarser as it grows longer (10.23). Whether an animal’s flesh and skin is soft or hard influences whether the animal can have white disease (λεύκη—probably white leprosy) and whether the animal’s hair will go grey (10.5 and 33; cf. 10.34). The nature of the animal’s flesh also influences whether hair will grow out of any scars the animal has (10.22, 27, and 29). In turn, the extent to which animals are moist and hot and the way in which breath (which is warm and moist) and nourishment are directed determine the condition of the animals’ flesh and skin.

Given that the nature of flesh influences hair growth and the condition of flesh is explained by the extent to which an animal is moist and warm, it should come as no surprise to the reader that humans who are hairy are said to be especially moist and warm (*Pr.* 10.24). Many other features are explained by the extent to which an animal is moist and warm too. These include whether an

28 Mayhew (2011, 141–42) observes that most of the explanations of sexual reproduction in *Pr.* 4 are also material explanations. Given Aristotle’s idea that natural generation is typically *for the sake of* some end, we might expect to find teleological explanations given a dominant place in the discussions in Book 4 too.

29 In the analysis that follows, I am including both the chapters that are concerned with differences in hair primarily and the chapters that have as their primary concern other phenomena, such as the occurrence of white disease, but include reasons for differences in hair.

30 Cf. Aristotle’s explanation of eyelids, which takes the relation between thickness of hair and thickness of skin as an assumption (*PA* 2.13.567b11–13).

animal is lustful.³¹ Whether an animal is moist or dry factors into the explanations presented in eighteen chapters in *Pr.* 10. Nourishment factors into fifteen chapters, the concoction of nourishment/nutriments is noted in eight chapters (four chapters include claims about both nourishment and concoction), and thirteen chapters include mention of residues, excretions, or excrement. All of these are thoroughly material concerns.

The tension between our expectation of finding teleological explanations in an Aristotelian work on problems in the natural sciences and the material explanations we find in *Pr.* 10 is heightened by the occurrence of passages that provide material explanations for phenomena for which we know Aristotle had developed teleological explanations. Consider, first, *Pr.* 10.47. This chapter concerns why some animals copulate once or at only one season while other animals copulate more often or do not have a specific mating season. The explanations provided focus on material factors: nourishment, warmth, and exertion. Chapter 47 also includes the claim that the duration of gestation influences how often animals copulate—for the most part, pregnant animals do not desire for they are already “filled” (896a27–28).

The content of *Pr.* 10.47 is consistent with many of the observations presented in Aristotle's *HA* 5. We are not told in the *Problemata* how, exactly, changes in nourishment influence the mating seasons of animals. We might expect, however, that the mating habits of specific kinds of animals would differ according to the nourishment available to animals of the kind. In *HA* 5 Aristotle reports just this when he claims that domesticated animals often mate more often than the same kinds of animals in the wild owing to the shelter and food provided to them (5.8.542a26). Confirming the suggestion that the gestation period of animals influences the frequency of their mating, Aristotle further reports that animals with short gestation periods breed more frequently than animals with longer gestation periods. Another similarity exists in so far as both *Pr.* 10 and *HA* 5 include the claim that animals of a single kind often have different mating seasons depending on where they are located (*Pr.* 10.47.896a24–26 and *HA* 5.11.543b25)—presumably, this is because the relative heat of the season in each region aids the work of concoction and makes the work of perfecting the offspring faster.³²

31 *Pr.* 10.24 suggests that heat and moisture are the common causes of hairiness and lustfulness.

32 For the manner in which the heat of the season influences the length of time it takes to generate offspring, see 753a17 where this point is made explicitly in relation to the perfection of eggs. The heat of the region or season can also influence whether offspring are male or female (*GA* 4.2).

The most significant difference between the explanations we find in the *Problemata* and in Aristotle's *Historia animalium* is that the latter includes a teleological explanation for differences in the mating habits of animals and the former does not. *Historia animalium* includes the idea that "[m]any [kinds] of animals have in view the upbringing of their young and choose a season for pairing which will fit in with their requirements." (5.8.542a30–32) In *HA* 5.33, Aristotle makes the same claim when he observes that the different four-footed egg-laying animals copulate at different seasons "depending upon how the approaching season favours the generation of their offspring" (558a3). Since Aristotle would think such deliberate planning is beyond most animals' capacities, it is plausible to read this claim as reflecting the "planning" of the animals' natures.³³ However we read this claim, it represents a teleological explanation for the particular breeding season of some animals.

At first glance, *Pr.* 10.62 is another chapter in which we find material explanations of phenomena for which Aristotle has provided teleological explanations. This chapter concerns why humans have proportionately more hair on their heads than on their bodies while the opposite is true in other animals with hair. The explanation developed in this chapter focuses on the nourishment available for growing hair: "a human neither lacks [such nourishment] nor has enough [for it to go] everywhere" (898a29–30). In contrast to what we find in 10.62, the explanation of the same phenomena in *PA* 2.14 highlights both material *and* final causes:

[w]ith respect to the head, mankind has the most hair of animals, *from necessity*, on account of the moistness of the brain and on account of the sutures (for where there is much moisture and heat there must be much growth), and *for the sake of* protection, so that it may provide covering, warding off the extremes of both cold and heat. And since the human brain is the most moist, it is also most in need of this protection; for what is moist boils and freezes most easily, while what is in the opposite state is less easily affected (658b3–10).

Aristotle's claim is that it is both necessary³⁴ and for the sake of protection that humans have lots of hair on their heads. *Pr.* 10.62 focuses only on the material

33 Aristotle claims that "[i]n all of this nature acts like an intelligent workman" (*GA* 1.23.731a25). For an analysis of this idea, see Leunissen (2010) and (2013). See also Henry (2013).

34 For Aristotle, *necessary* can mean either materially necessary or conditionally necessary. Lennox (2001a, 233) suggests that the necessity is "presumably" conditional in this passage.

and includes no mention of the purpose. Before I address this discrepancy, I will consider chapters presenting material explanations for phenomena for which Aristotle himself provides material explanations. This will allow me to make clear how material and teleological explanations are related in Aristotle's science of nature by making clear the place for material explanations in relation to Aristotle's teleology.

4 Material Explanations: *Pathemata* and Monstrosities

Many of the phenomena for which material explanations are provided in *Pr.* 10 are explained in *GA* 5. This observation is significant for our analysis of the content of *Pr.* 10 in so far as the explanations presented in *GA* 5 are, almost exclusively, material explanations. Aristotle announces there that he is moving on to study the differences in conditions (παθημάτα) of the parts of animals (778a16): e.g. differences in eye colour,³⁵ differences in hair (such as hardness, length, and colour), pitch of voice,³⁶ and so on. He asserts that these differences “are not characteristics belonging to nature in general, nor peculiarities proper to this or that particular class of animal” (778a31–32) and adds that these conditions do not come to be *for the sake of something* (778a32–33). For clarity, Aristotle has us consider the distinction between the coming to be of an eye, on the one hand, and the blueness of the eye, on the other. Whereas the eye comes to be for the sake of seeing, the blueness of the eye is not for any specific end “unless this condition is a peculiarity proper to the particular class of animal” (778a33–34).³⁷ Given that the conditions to be explained in *GA* 5 do not come to be for the sake of anything, we should expect that these conditions

35 The blueness of eyes in some humans and some horses is the focus of *Pr.* 10.11. Though I do not discuss this chapter at length, it provides another case in which the content of the explanation in the *Problemata* does not obviously match what we find in Aristotle's biological treatises. In the former, the suggestion is that eye colour follows the colour of the body. In the latter, the explanation is tied to the amount of fluid in the eye (see *GA* 5.1.779b20). One detail explicit in Aristotle's works, but not noted at all in the *Problemata*, is the relation between eye colour and strength of sight. See *HA* 1.10.492a1–3 in addition to *GA* 5.1.

36 Voice is the problem of note in *Pr.* 10.38–40. Problems concerning voice are also the focus of *Pr.* 11. In Aristotle's work, voice is the focus of *GA* 5.7. Voice and rational speech are taken up in other works by Aristotle too. See, for examples, *DA* 2.8, *HA* 4.9, and *Pol.* 1.2.

37 Since eye colour is related to strength or weakness of sight (the lighter the eye-colour, the weaker the sight tends to be) and some animals must have keen eyesight, the uniformly coloured eyes among these kinds is related to the animal's nature. Eagles, for example,

will not have teleological explanations.³⁸ Indeed, this is just what Aristotle signals in noting that, in these cases, the condition to be explained “has nothing to do with the *logos* of the animal’s being; [and] we are to assume that these things come to be *by necessity*, and so their causes must be referred back to the matter and to the source which initiated their movement” (778b34–37). Aristotle’s insistence that causes *must* be referred back to the matter makes clear that the necessity in question is material necessity.

GA 5 reflects Aristotle’s distinction between features of animals that come about for the sake of some final cause and features that come to be without any specific purpose. The former are the features of animals tied to the *logos* of the animal’s being—those parts that are conditionally necessary for the sake of being an animal of a certain kind. These include feathered wings on birds and other features we would say are essential features of each animal kind. Presumably, the former includes also those features that are for the better if not strictly necessary to be an animal of a certain kind. Kidneys, for example, are not necessary parts, but come to be for the reason that it is better for animals with kidneys to have this feature in so far as the kidneys contribute to the well-functioning of the bladder (*PA* 3.7.670b23–26). The features that serve a purpose reflect the work of the animal’s nature. They are, as Gotthelf says, the realization of each animal’s potential for form—the product of each animal’s goal-directed nature.

The latter are the features of animals that come into being despite the facts that they are not necessary for being an animal of any specific kind and that they are not for any specific purpose.³⁹ Aristotle’s example of eye colour is a good one. Since having eyes of a certain colour is not necessary for being a human (humans have different colours of eyes), the colour of each person’s eyes is a feature for which we should not expect a teleological explanation. Differences in features of this kind are the result of material processes involved in natural generation.

We might expect to find that the material explanations we find in *Pr.* 10 match the corresponding material explanations in GA 5. In fact, we find that the relevant explanations in *Pr.* 10 are the same *kind* as the corresponding explanations in *De generatione animalium*, though these explanations do not

require keen eyesight given that they are high-flying hunters. There is a sense, then, in which the colour of the eagles’ eyes is proper to this keen-sighted animal.

38 The exception is the discussion of teeth in the final chapter of GA 5.

39 Leunissen (2010) distinguishes between the *coming to be* of animals’ parts and the *possession* of those parts. Here, my point is about the *coming to be* of the parts.

match in every detail. Consider, for instance, the relevant explanations of differences in hair.

Among the differences in hair to be explained in *GA* 5 are differences related to the hardness or softness of hair, the length or shortness of hair, whether hair is straight or curly, and whether hair is plentiful or scanty. Differences in the colour of hair are also to be explained. Aristotle notes that there is a “purpose for the sake of which Nature has made hair in general and provided animals with it” (782a21–23).⁴⁰ He then reasserts the programmatic remarks from the start of *GA* 5 with the claim that “[t]he business of our present investigation is to show what are the pre-existing circumstances, what are the factors of *necessity*, on account of which the particular sorts of hair occur” (782a22–23). This signals that *GA* 5 is focused on providing material explanations for the various conditions of hair. Certainly, the chapters in *Pr.* 10 concerned with the various conditions of hair are material explanations and, in this respect, they are explanations of sort promised in *GA* 5.

Consider the chapters concerned with why white disease occurs in humans but not in other animals: 10.5 and 33. *Pr.* 10.5 suggests that the cause of white disease is a combination of being very full of breath and having thin skin. This matches the explanation of white disease outlined in preceding chapter (i.e. 10.4) where white disease is said to be an exiting of breath. 10.5 includes the additional suggestion that the combination of thin skin and fullness of breath also explains why greying only occurs in humans. After reading the explanation of differences in the colour of hair in *GA* 5, we can supply the details to understand how this works: the fullness of breath is what causes the whiteness of skin and the thinnest skin is the most easily affected. It is presumably for these reasons that “the white disease occurs most and first on the parts where the skin is thinnest” (10.5.891a37). And, where the skin is affected, so too is the hair that grows from the skin. The idea that the condition of the skin is related to the condition of hair is explicit in 10.34 where the relation between white disease and greying is explored and also in *GA* 5.4 (see 784a29–31).

Pr. 10.33 draws together the idea from 10.4 that white disease is an excretion of breath and the idea that white disease only occurs in humans because “the human is by nature most thin-skinned” (894b3). White disease isn’t observed in other animals for the reason that the thickness of their skin prevents the excretion of breath. In 10.34, we find the claim that white disease is only one cause of grey hair. Aristotle similarly recognizes that there are multiple causes of white or grey hair in *GA* 5 (784a25 & 786a10). In all of the chapters in *Pr.* 10 concerning the occurrence of white disease, the details are consistent with one

40 Recall *PA* 2.14.658a18 cited above.

another and are remarkably close to what we would expect to find if the author were familiar with *De generatione animalium*.⁴¹

If all of the explanations in *Pr.* 10 matched the corresponding explanations in Aristotle's biological works with the same level of consistency, we could be very confident that the author of these chapters meant for the chapters to capture Aristotle's original explanations. Many of the explanations for the conditions of hair in *Pr.* 10, however, include details that rub against the details we find in Aristotle's works. Consider *Pr.* 10.22:

Why does the hair of sheep grow in softer when it is plucked, while human hair grows in harder? Is it because the hair of sheep grows from the surface? And this is why it is also drawn out painlessly, as the source of the nourishment, which is in the flesh, remains undamaged. So when [the passages] are open the residues evaporate more easily, and the wool receives proper nourishment from the flesh . . . but human hair grows from deep down, and is drawn out only by force and with pain. . . . Therefore, when the region is wounded, the result is also that it is scarred. This is why in the end this happens to those who are plucked; but as long as the hair grows again, it grows in hard, because all the nourishment that nourishes the flesh has left it, and it comes to be from residues. (893a17–31)

In *GA* 5.3, Aristotle claims that the “chief cause” of the thickness and thinness of hair is the skin (782a24–25) rather than the depth from which the hair grows in each kind of animal (*Pr.* 10.22.893a19–20). Contrary to the explicit suggestion in the *Problemata* that flesh is the source of nourishment for hair (893a19) Aristotle insists that “hair and its counterparts are formed *not out of the flesh* but out of the skin” (782a31–32, emphasis added).⁴² According to Aristotle's account, the amount and quality⁴³ of fluid present in skin contributes to its thickness. As the fluid from the skin evaporates we are left with the earthy material from the skin which constitutes the hair. Thick skinned animals tend

41 Though the chapters in *Pr.* 10 that are concerned with the colour of hair do not mention the relation between heat and the quantity of breath present in each animal, the explanations we find there are otherwise consistent with the explanations for the greying of human hair Aristotle develops in *GA* 5. Perhaps the fact that the explanations suggested in *Pr.* 10 do not go into the same amount of detail is owing to their short length in contrast to the extended discussion in *GA* 5 where the problems related to differences in the colour of hair run to almost two full chapters and approximately three Bekker pages.

42 See also, *HA* 3.10.517b8–10: “Difference of thickness and length of hair are observed according to the different regions of the body where it occurs, and according to the character of the skin on which it grows.”

43 I.e. whether or not the fluid is greasy (782b14) since greasiness slows evaporation.

to have thick hair because of the quantity of earthy material available from the skin. In contrast to what we find in the *Problemata*, Aristotle does not comment on the relation between the depth at which hair grows in each kind of animal. We must conclude that the explanation suggested in *Pr.* 10 is not consistent with the explanation Aristotle outlines in *GA* 5 though both explanations are of the same kind in so far as they are both material explanations for differences that are not functional differences.

Consider, for further evidence, the collection of chapters concerned with eunuchs.⁴⁴ *Pr.* 10.36 concerns why eunuchs change into the female when mutilated. The specific ways in which eunuchs change are outlined and the account is consistent with the details set out in Aristotle's biological treatises (though some details are mentioned in one text while not the other). The main problem to be explained in *Pr.* 10.36 matches a claim Aristotle repeats in the biological works: that eunuchs change into the female form. According to Aristotle, this is because destroying or removing the male generative parts changes the animal so much that it becomes nearly female (see *GA* 1.2.716b1–7, 4.1.766a25–30, and *HA* 7(8).2.589b31–590a2).⁴⁵

In *Pr.* 10.37, it is suggested that eunuchs generally do not have varicocele for the reason that they change into the same form as the child and women in so far as all of these are sterile (presumably meaning they lack the power to initiate the generation of offspring).⁴⁶ Again, in 10.42, it is suggested that eunuchs have sores and wounds on their legs just for the reason that women have the same. In that chapter, the author claims that neither eunuchs nor women are hairy because of their abundant moisture. And, in 10.57, we are told that eunuchs do not go bald because they have a big brain as a result of not associating with women—the semen, as noted above, is said to flow from the brain through the spine.

44 My focus is on those chapters in *Pr.* 10, but see also 4.3, 11.16, 11.34, and 11.62. In *Historia animalium*, an entire chapter is devoted to outlining the consequences of castration. A lack of baldness and differences in voice are but two of the consequences identified (see *HA* 8(9).50.631b20).

45 One change is related to voice. In *GA* 5.7, Aristotle notes differences in the voice and observes that eunuchs give voice like that of the female. Again, this is for the reason that they “change over to the female state” (787b20). The material explanation that follows points to the way in which the testicles are normally connected to the region around the heart and how a change in the sinewy parts connecting the testicles results in a change in voice (cf. *HA* 3.1.510a35–b4 describing a diagram of the relevant parts).

46 In *HA* 3.11 Aristotle observes that those who suffer from varicose veins go bald less than others and that no children, women, or eunuchs go bald. No explanations are offered there.

This explanation in *Pr.* 10.57 is surprising in two ways, one of which—the assumption of a pangenesis theory—is discussed above in section 2. The other is that the explanation in this chapter is not consistent with Aristotle's explanation of baldness. In *GA* 5.3, Aristotle claims that balding is explained by the size and fluidity of the human brain. This is, by nature, the coldest part of the body and the skin around it has very little heat. Thus, the hair has even less heat. Aristotle goes on to assert that sexual intercourse makes men cold. Once men are sexually active, there is a slight loss of heat that leads to balding: already the brain, skin, and hair are weak owing to a lack of heat, and this small change (i.e. the loss of heat owing to sex) causes baldness. Aristotle repeats in this chapter that women and children do not go bald (782a9–11) and explains that eunuchs do not go bald “because of their transition into the female state” (784a4–11).⁴⁷ Spelling out the details, eunuchs do not produce semen and do not engage in sexual intercourse. Thus, they do not cool in the same way men cool at the end of the stage of life at which they are sexually active.

While the possession of a large, cool brain with abundant fluidity is exactly what causes baldness in Aristotle's account, in *Pr.* 10 the eunuch is said to be both moist (10.42) and big-brained (10.57), but does not go bald. Further, while the production of semen seems to be part of both explanations, baldness occurs because sexual intercourse results in the cooling of the male according to the account in *De generatione animalium*, while the lack of semen seems to result in a larger brain according to the account in *Pr.* 10. Again, we must conclude that the explanations presented in *Pr.* 10 are the same kind of explanations we find in *GA* 5—both are material explanations—though the details of the explanations are not consistent with Aristotle's.

Focusing on the fact that many of the natural phenomena to be explained in the chapters of *Pr.* 10 are those for which Aristotle has principled reasons to provide material explanations in *GA* 5, we might ask whether other phenomena considered in the *Problemata* are of the sort that Aristotle would explain in material terms.

Seven chapters in *Pr.* 10 are concerned with, or include comments about, what Aristotle would count as deformities, defects, or monstrosities.⁴⁸ In 10.8, for example, it is suggested that females are smaller than males owing

47 Aristotle is consistent in claiming that eunuchs do not go bald (see, for examples, *HA* 3.11.518a30–31, *HA* 9.50.632a4, and *GA* 5.3.784a6–7).

48 In addition to the ones discussed, the others are: 10.10 (on the resemblance of offspring to parents), 10.12 (on dwarves and pygmies), 10.24 (which includes a comment about lame men), and 10.40 (explaining stammering as a result of an inability owing to a part that is not wholly formed).

to the fact that males are hotter and, thus, are more complete or perfect. This matches Aristotle's account of women as deformed, or impotent, males (see, especially, *GA* 1.20.728a16–21). In 10.41, it is claimed that humans are more likely to be born lame than any other animal for the reason that human gestation is long and human limbs are relatively weak—a combination resulting in many breaks and deformities.⁴⁹ 10.61 concerns why some animals are more likely than others to bear monsters (τέρατα). The explanations included in these chapters focus on the material aspects of embryogenesis. In so far as they focus on the material explanations of deficiencies, deformities, and monstrosities, these chapters present just the sort of explanations we would expect from any author working in the Aristotelian tradition. Aristotle himself holds that monstrosities occur when the material is not controlled (*GA* 4.3.769b12). Whereas the animal's formal nature typically masters the material nature (4.4.770b17), the cause of monstrosities “lies in the material” (770a6 and 770a31). And this allows that monstrosities are cases in which “even that which is contrary to nature is in a certain sense according to nature” (770b13–16). Monstrosities represent failures of the directedness of nature towards an end and the final cause is not fully realized owing to the animal's material nature.

5 Teleology in *Pr.* 10

To this point, I have been focusing on the chapters of *Pr.* 10 that present material explanations for natural phenomena. This might suggest, misleadingly, that there is nothing that could be counted as a teleological explanation in this book. Some chapters in *Pr.* 10 reflect teleological assumptions, though the teleological aspects of the explanations in these chapters are never highlighted or emphasized. In most cases, they are not even explicit. Whatever teleological explanations we do find in *Pr.* 10 are rare. I consider these now.

Pr. 10.19 (in its entirety) asks, “Why is the tongue of animals never fat? Is it because what is fat is dense, but the tongue is naturally porous, *so that it may recognize flavors?*” (892b33–35, emphasis added). Here, the material nature of the tongue is tied to its function as the organ of taste. We find the same explanation in *PA* 2.17 where Aristotle claims that the tongue is well suited for sensing flavours (660a18–22).⁵⁰ He says there that a soft tongue is adapted to sensation. The reason is that a soft tongue is impressionable by touch and

49 *Pr.* 10.46 suggests that the length of gestation also influences the size of the navel.

50 In this passage, Aristotle identifies a “double purpose” of sensing tastes and of playing a part in articulating sounds.

taste is, or involves, a kind of touch.⁵¹ Again, in *Pr.* 10.26 (discussed above in section 2), it is implied that the fact that all animals with feet have an even number of feet is because pairs of feet are needed *for the purpose of* walking or running. Though these chapters include appeals to final causes, that they are teleological explanations is not emphasized. These chapters lack even Aristotle's typical language of identifying the final cause as that "for the sake of which" (οὗ ἕνεκα) the feature in question comes to be. That the tongue's purpose is recognizing flavours and that feet are for walking is, however, very clear.⁵²

We find further evidence of Aristotle's teleological assumptions in *Pr.* 10.45 where the distinction is drawn between nature "at the beginning" and nature as "that toward which" animals develop (896a3–4).⁵³ This is the distinction between nature as moving cause and nature as final cause that is familiar to us from Aristotle's own works.⁵⁴ (Recalling that *Pr.* 10.45 is one of the chapters that includes claims that are undermined by facts Aristotle records in his *Historia animalium* about the possibility of animal kinds that are both tame and wild, this chapter is another instance in which we find the same *kind* of explanation we would expect from Aristotle while the author of the chapter is almost certainly not Aristotle.)

Perhaps the clearest example of teleology in *Pr.* 10 is found in chapter 53. This chapter is concerned with why humans are hairier on their front parts while other animals with hair are hairier on their backs. One suggestion is that the front parts are hairier in all two-footed animals. Another suggestion is that,

51 This is consistent with the account we find in *DA* 2.10. Presumably, the fact that the tongue is porous means the tongue is soft in the manner required to serve as the organ of the touch and other aspects of the tongue make it well suited for forming articulate sounds. At *HA* 1.11.492b27–35 Aristotle notes differences in animals' tongues, but does not tie the softness of the tongue to the power of taste explicitly.

52 Though I do not analyze it here, *Pr.* 10.15 (concerning the distance between the eyes of humans in contrast to other animals) similarly reflects that the purpose of eyes is related to motion in the ways we would expect after reading Aristotle's *De anima*.

53 The specific explanation suggested in this chapter is extensive—fuller, in its particular details, than what we find in Aristotle's biological treatises. It is unique in this respect. We do, however, find more information in the *Politics*. In a discussion about natural slaves, for instance, Aristotle claims that tame animals have a better nature than wild animals (1.5.1254b10–11).

54 The nature of each natural object acts as an efficient cause for the sake of realizing its own form. See, especially, *DA* 2.4.415a25–b7, *GA* 2.1.731b24; and the passages cited above from *PA* 1.1.

nature is always accustomed to shield the weaker parts more, and each [animal] is weak in some way... [and] in all the four-footed animals the back parts are weaker than the front parts because of their position, for they can suffer more from both cold and heat; but the front parts of humans are weaker and suffer in the same respects. (896b33–39)

Two aspects of the second suggestion reflect its teleological nature. The first is the goal-directed agency attributed to nature. The second is that the distribution of hair on the bodies of humans and other animals is decidedly for the purpose of protecting certain parts of the animals. Both of these elements are included in the explanation of the same phenomenon in Aristotle's *De partibus animalium*.

In a digression from his discussion of eyelids and eyelashes in *PA* 2.14–15,⁵⁵ Aristotle claims that,

[h]air is present in those that have it for the sake of covering. Now in four-footed animals the backs have a greater need for covering, and through their fronts are more valuable, they are nevertheless hairless because they are bent over. But in human beings, since on account of their upright posture their fronts and backs are on equal terms, nature adds this protection to the more valuable parts; for it is always a cause of the better among possibilities. (658a14–24)

James Lennox (2001a) explains that, for Aristotle, the “more valuable” parts are those near the front of the body where we find the organs of perception and the heart.⁵⁶ To all of this, Lennox (2001a, 232) adds:

The claims here are hard to credit. Aristotle surely knew of four-footed animals, such as cats, that have hair on their ‘chest’ and ‘bellies’. In many it does not even seem credible to claim that there is *less* there than on the back. Conversely, however little there may be, in most cases it is considerably more than most human beings have, a point Aristotle himself makes at *HA* 2.1, 498b16–18.⁵⁷

55 Aristotle notes explicitly at 658b11 that this is a digression and suggests that further discussion should be made on the appropriate occasions.

56 Lennox cites *IA* 5.706b11–16 and *PA* 3.4.665b18–21. Aristotle is clear that the front part is where “sense is naturally located” (*IA* 4.705b11). See also *PA* 2.10.656b22 regarding the place of sensation and the heart in the ‘front’ of animals.

57 Aristotle recognizes different patterns of hair even on the four-legged animals in *HA* 2.1 too. See, especially, 498b26–499a1.

Perhaps it would be better to treat Aristotle's claims about the patterns of hair on human and non-human animals as overstated generalizations (for just as Aristotle surely knew of hairy-bellied four-footed animals, *most* four-footed animals tend to have less hair on their fronts than on their backs).⁵⁸ Whatever we think of these "hard to credit" claims, they are certainly the same ones presented in an uncritical manner in *Pr.* 10.53. Without questioning *whether* the four-footed animals really have more hair on their backs than their fronts, *Pr.* 10 invites us consider *why* this would be so.

There are two differences of note between the explanation in *Pr.* 10 and the explanation outlined in *PA* 2. First, *Pr.* 10 suggests that nature protects the *weaker* parts (ἀσθενέστερα) whereas *De partibus animalium* maintains that nature is protecting the more *valuable* parts (τιμιώτερα). Second, the explanation in *De partibus animalium* emphasizes the manner in which nature works towards what is better or best for the animal whereas this aspect of Aristotle's natural teleology is not explicit in *Pr.* 10—in ch. 53 or elsewhere.

Nevertheless, both *Pr.* 10 and *De partibus animalium* reflect Aristotle's assumption that nature "is constrained in its actions by both the type and the quantity of material constituting the animal in question" (Lennox 2001a, 233). Aristotle is explicit in *De partibus animalium* both that nature "is always a cause of the better among possibilities" (2.14.658a24, as cited above)⁵⁹ and that "nature everywhere gives to another part what it takes elsewhere" (2.14.658a34–35).⁶⁰ There would be no need to direct matter of a certain kind to one part of the animal *rather than* another unless it wasn't possible to direct that kind of matter to both parts. It is precisely the assumption that

58 This suggestion, however, raises questions about the manner in which Aristotle groups animals in order to explain their features. See Gotthelf (2012) and Lennox (1987). On Aristotle's grouping of animals for the purposes of explanation, see also and Bayer (1998), Henry (2011), and Stoyles (2012).

59 See also *IA* 2, where Aristotle postulates that "some of the principles we are accustomed constantly to use for our scientific investigations of nature" and that "we must take for granted principles of this universal character which appear in all nature's work." (704b11–13) The first of these principles is that "nature creates nothing without a purpose, but always the best possible in each kind of living creature by reference to its essential constitution" (704b15–17). He proceeds, then, to note assumptions we must make in relation to what we can call the material or mechanism of motion: the sources of locomotion are thrusts and pulls. He goes on to consider some mechanics of jumping and running.

60 The second claim is found in the part of the discussion concerning the length of animals' tails in relation to the hairiness of their bodies, but Aristotle certainly thinks the claim will apply in all questions related to the distribution or patterns of hair on animals that have hair.

nature has only so much matter with which to build each kind of animal that underlies Aristotle's explanations.⁶¹ The recognition that nature is constrained by the type and quantity of matter available for the generation of animals' parts reflects one limit to teleological explanations in natural science in so far as nature's goal-directed work is constrained by the material with which it must work.⁶² To make clear just how the relevant material and teleological explanations are related, I turn now to the task of identifying the place for material explanations within Aristotle's natural teleology.

In *PA* 1.1 Aristotle calls for us to focus on final causes in our explanations of natural phenomena. He also draws our attention to the way in which the generation of natural objects involves conditional necessity: "[I]t is necessary that a certain sort of matter be present if there is to be . . . any . . . end" (639b26–27; cf. *Phys.* 2.9). Aristotle's notion of conditional necessity requires that any complete explanation of natural substances will reflect the manner in which the formal, functional, nature of the substance relies on its having a material nature of a particular sort. Where conditional necessity is involved, there is a place for both teleological explanations and material explanations though the material explanations are, for lack of a better idiom, subordinate to the explanations involving final causes.

Aristotle also recognizes that nature, which directs the generation of animals, must somehow initiate material changes in the various stages of coming to be. In *De generatione animalium*, Aristotle repeatedly points to the amount of heat and moisture (and, to a lesser extent, the amount of earthiness) of each kind of animal to explain the generation of offspring of that kind.⁶³ The hot and moist animals produce the most perfect offspring whereas the coolest animals produce the least perfect offspring. Aristotle also focuses on the way in which heat and moisture account for the various stages of generation, including the generation of the functional parts of animals—i.e. those for which teleological explanations can be given. The reason is provided in *GA* 2.6 where Aristotle claims that,

61 Cf. Plato's discussion of the thinness of the skull at *Timaeus* 74e1–75c7 and the Stoic Chrysippus' use of Plato's ideas. See Bryan (2013) for an account of the latter and a rich discussion of the senses in which a thin skull could be 'necessary' according to Plato and Chrysippus.

62 See Byrne (2002), the goal of which is to establish the limits of teleological explanations in Aristotle's science of nature by focusing on the significance of matter.

63 It goes beyond the purpose of this paper to explore specific passages. For these, see especially *GA* 2.

[h]eat and cooling ... are both employed by Nature. Each has the faculty, grounded in *necessity*, of making one thing into this and another thing into that; but in the case of the forming of the embryo it is for a *purpose* that their power of heating and cooling is exerted and that each of the parts is formed, flesh being made soft—as heating and cooling make it such, partly owing to *necessity*, partly *for a purpose* ... (743a36–b6)⁶⁴

From this it is clear that all teleological explanations are complemented by material explanations for the reason that nature, as that which is responsible for the goal-directedness of natural generation, uses heat to actualize each animal's potential for form in the matter of each organism. In this way, we can understand Aristotle's comment, in *GA* 2.1, that "just as we should not say that an axe or other instrument or organ was made by the fire alone, so neither shall we say that foot or hand were made by heat alone" (734b28–30). Heat is, thus, a first principle of sorts in so far as it is the first motive-material cause of natural generation (743a1).⁶⁵ Since nature uses heat to bring about each animal's potential for form, a complete explanation of any functional organism will include mention of both the directedness of generation (i.e. the teleological aspect) and the mechanism of generation which starts with nature's use of heat. Aristotle's insistence that nature uses heat and cooling in the process of generation allows one way to explain the focus throughout *Pr.* 10 on heat and cooling, nourishment, and residues.

In some cases, Aristotle seems to think that the generation of specific parts of animals happens directly: this involves nature's use of heat to concoct material that becomes the animals' functional parts. In other cases, Aristotle asserts that material is concocted and *then* co-opted by nature in a manner that serves the animal well.⁶⁶ This kind of "indirect teleology"⁶⁷ reflects what Aristotle presents as nature's use of materials that come to be through material necessity. In these cases, material and teleological explanations complement each other in a very specific way in so far as nature is said to be using residues

64 This reflects the sense in which "all these things are formed partly as a result of *necessity*, partly also not of *necessity* but *for a purpose*" (*GA* 2.6.743b15–18; cf. 767a17).

65 In *GA* 2.4, Aristotle claims that the heart is formed first (in blooded animals) and that it is or has the first principle of both the homogeneous and heterogeneous parts—natural heat is in the heart.

66 The distinction I make between direct and indirect teleology is informed by Leunissen's (2010) distinction between what she calls "primary" and "secondary" teleology. The first kind of cases involves instances of what Leunissen refers to as "primary teleology." The second involves what she calls "secondary teleology".

67 See Lennox (2001a, 249).

that come to be by material, rather than conditional, necessity. The material being used is not generated for the sake of anything. It is residual or ‘extra’—we might think of it as a by-product of earlier stages of generation. Aristotle’s idea is that “sometimes nature even makes use of residues for some benefit, [and in these cases] it is not on this account necessary to seek what something is for in every case; on the contrary, when certain things are such as they are, many other things happen from necessity” (*PA* 4.2.677a16–18).

Nature does not dispose of material that can be put to use (see, for instance, *GA* 2.6.744b16–17); rather, nature co-opts this material for the generation of parts that are beneficial, though not strictly necessary, for the animal. Aristotle’s description of horns, for example, involves the direction of matter that is available to be co-opted by nature. That this matter is limited in quantity means that animals with horns might have fewer teeth than they might have had if the extra matter weren’t directed to become horns. As Mariska Leunissen (2010) has shown (see, especially her interpretation of *GA* 2.6.744b11–27 on pp. 82–83), Aristotle’s explanations of hair reflect this kind of indirect teleology.

Many chapters in *Pr.* 10 suggest explanations implying this same kind of *indirect* teleology. These include, for example, the explanation in *Pr.* 10.25 of why humans do not have manes. The chapter, in its entirety, asks, “Why doesn’t man have a mane? Is it because he has a beard, so that the nourishment from such residue, leaving the one place, goes to the jaws?” The idea is that man has a beard *rather than* a mane and this reflects the assumption that there is only enough matter available for a beard *or* a mane. And, though this chapter does not refer to nature explicitly, it is tempting to supply the detail that nature directs the matter available to the beard in humans.

The assumption that there is only enough material for nature to craft a mane or a beard parallels the assumption underwriting *Pr.* 10.53, where the goal-directed activity of nature is constrained by the kind and amount of material available. We have a beard *rather than* a mane and we have *only enough* hair to cover our weaker or more valuable parts. This same assumption allows us to reconsider *Pr.* 10.62 which I identified in section 3 as one of the chapters that seems to pose a significant challenge to the idea that its author accepts Aristotle’s natural teleology in so far as it presents a material explanation of a phenomenon for which with Aristotle provides a teleological explanation.

Pr. 10.62 presents an explanation for why humans have proportionately more hair on their heads than the other animals with hair. As I have noted in section 3, there is no mention of the purpose of hair, namely, the protection it offers the head in that chapter. Rather, it is suggested that “among the other animals some give up an excessive amount of nourishment to the teeth, others to horns, and others to hair [and that] those that give this up to horns

have less hair on the head; for [the available] nourishment is used up on the horns" (898a22–25). Knowing that, on Aristotle's view, hair is made from residues that are generated by material necessity and that nature co-opts these residues for the sake of what is better for the animal, we can interpret the explanation in 10.62 to include the idea (albeit tacitly) that there is nourishment resulting from material necessity that is available for nature to co-opt to form hair, or teeth, or horns, or whatever else. Presumably, nature directs this matter towards becoming hair rather than horns, or whatever else, in humans. Further, it must be that there is only enough of the suitable material available in humans for thick hair on the top of the head and a beard. (Birds, in contrast, have enough extra nourishment to cover their whole bodies with feathers.) Though there is no mention of *why* the available nourishment would be directed to become hair in humans rather than horns, the explanation in *Pr.* 10.62 fits well with the more robust teleological explanation we find in Aristotle's biological works.⁶⁸

6 Conclusions

My analysis of the content of *Pr.* 10 in relation to the content of Aristotle's biological works supports the conclusion that this book is a compilation of chapters written by different philosophers who accepted Aristotle's natural teleology. Many of the chapters concern natural phenomena—including *pathemata*, monstrosities, and defects—for which Aristotle thinks only material explanations can be given, while other chapters concern phenomenon that are the result of *indirect* teleology. In all of these chapters, the explanations are the same *kind* of explanations we find for the same phenomena in Aristotle's biological works, whereas the lack of consistency in the *details* of these explanations reflect the fact that most of the chapters in *Pr.* 10 are not written by Aristotle.

Specifically, my analysis establishes that:

1. Some chapters, e.g. *Pr.* 10.26, could have been written by Aristotle himself in so far as they represent a strong summary of the more extensive explanations Aristotle generates in his biological works;

68 This explanation can be compared with the explanation suggested in 10.57 outlined above.

2. Some chapters, e.g. *Pr.* 10.28, are consistent with what we find in Aristotle's biological works, but contain too little information for us to read them as summaries of Aristotle's own explanations;
3. Some chapters, e.g. *Pr.* 10.22, 44, 45, and 57, cannot have been written by Aristotle, in so far as they include details that conflict with the details we find in Aristotle's biological works.
4. All of the chapters in *Pr.* 10 are consistent with Aristotle's natural teleology, even if there is little that is explicitly teleological in *Pr.* 10.

Perhaps the most pressing questions for us in reading *Pr.* 10 concern why this book focuses on phenomena of the sort that are appropriately accounted for with material explanations and why the explanations of phenomena for which teleological explanations can be given focus, instead, on material explanations. These questions, however, must be left for a different project.

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Sound Reasoning in *Problemata* 11? Disentangling the Components of Voices

Stefan Hagel

Most ancient authorities on the matter of sound believed that its pitch depended on its speed,¹ a notion that modern readers, educated in the idea of sound as vibration, quite easily dismiss as entirely mistaken: as we all know, the velocity with which sound propagates in a given medium (and at a given temperature) is fixed, so pitch and speed are entirely unrelated. Or are they not? After all, propagation is not the only way of conceiving speed in sound. At the level of the particle, it seems clear that faster oscillation means faster moving molecules, other factors being kept equal. So, does pitch depend on speed, in the end? Yet greater *volume* also increases particle velocity, since a movement within a larger amplitude means completing a longer course within the same time span (as defined by the frequency). As a result of this double connection of speed to both pitch and volume, particle velocity is usually not mentioned at all in modern accounts of sound. However, it may be fruitful to bear those relations in mind before accessing, and perhaps too rashly frowning upon, ancient sources, which hardly ever make clear, when ascribing properties of sound to speed, what exactly it is whose speed they have in mind.

In any case ancient acoustics, even where it defined sound as a sequence of impacts and pitch as their density in time and thus came remarkably close to the modern notion of frequency,² apparently never considered explicitly the fact that (particles of) air, after contributing to the propagation of sound by displacing their neighbour(s), would return much to their original position, a

1 There is good reason to believe that the theory originated with Archytas (Huffman 2005, 138–40), though speed is mentioned in a musical context in connection with Lasus and Hippasus (Theon 49.7–12).

2 The most evolved version of this concept appears in [Eucl.] *Sect. can.* 1 (cf. Barker 1989, 192 n. 2) and *Pr.* 19.39, but with potential precursors possibly even preceding Archytas: Porph. *in. Ptol.* 107.15–108.21 Düring, convincingly explained in Barker (1989, 35 n. 27). In none of these sources, however, is propagation velocity explicitly ruled out as a factor, so that higher frequency of impacts might also be envisaged, for instance, as resulting from impacts of entities separated by a similar spatial distance but moving at a higher speed (cf. Barker 1989, 95 n. 64).

notion that would have been prerequisite to appreciating fully the nature of longitudinal waves.³ And the physical models employed in the *Problems* are still a good deal simpler. In the following I will briefly discuss their nature, also in relation to other, mostly Peripatetic, writings, and eventually propose an interpretation of a particularly problematic passage, tentatively attributing to it an especially refined view.

Apart from not acknowledging the nature of oscillation, the ancient accounts are often hampered by confusion between notions that we would distinguish into velocity on the one hand and impulse or pressure on the other (the latter depending on the former as well as the mass of the moving item, potentially divided by the area of impact).⁴ Sometimes, starting with Archytas, it is taken for granted that speed and force are directly correlated and therefore might be referred to interchangeably (e.g., βραδέως καὶ ἀσθενῶς); note however that this does not imply that the *amount* of whatever moves in the propagation of sound is conceived of as always being identical—a distinction clearly exposed in Plato's *Timaeus* (67b–c). The earliest extant account by Archytas is informed by experience with sounding tools such as the bullroarer, where the application of stronger force results both in faster motion and higher pitch. In most cities, any educated citizen was also familiar with the procedure of tuning a lyre, where a higher pitch required higher tension and therefore more force; the tauter strings vibrated more quickly, just as a tauter bow would give a higher sound and project the missile with higher speed and force.⁵ Tension and relaxation were apparently also experienced as the factors that govern pitch in the human voice. However, transferring the idea to woodwind instruments was less straightforward: Archytas suggested that the breath slowed down when travelling through a longer section of tube, obviously disregarding the notion that producing bass notes on the aulos required significantly more

3 Heraclides, in a detailed account of the relation between the vibration of a plucked string and the perceived sound (Porph. *in. Ptol.* 31.7–21 Düring), conceptually translates the string's continuous oscillatory motion (κινεῖσθαι σειομένην καὶ ἐπὶ τὸν αὐτὸν τόπον ἀνακάμψεις ποιεῖσθαι) into a series of distinct impacts (καθ' ἐκάστην δὲ πρόσκρουσιν), each apparently carrying the note's pitch, which are subsequently blurred by the hearing (cf. Barker 1989, 236 n. 119); cf. *Aud.* 803b32–40.

4 For a more systematic discussion of the history of the notions involved, cf. Rocconi (2003) and, with a focus on the dependence of ancient theories on pre-scientific language, Barker (2002); on *Pr.* 11 in particular, see Petrucci (2011).

5 For the common awareness of the analogy between bow and lyre string, cf. *Od.* 21.406–11 and Heraclitus fr. 51 DK, as well as the fact that both the lyre and the bow were attributes of Apollo.

effort.⁶ More seriously, the nice dichotomy of high pitch (ὀξύτης), swiftness (ταχυτής), energetic tension (συντονία) and force (ισχύς) on the one hand, as opposed to low pitch (βαρύτης), slowness (βραδυτής), relaxation (ἄνεσις) and weakness (ἀσθένεια) on the other, was shattered by the observation that children, females, old men, and eunuchs all sound higher than adult men. *Pr.* 11 repeatedly reverts exactly to this challenge. Writers less concerned with musical questions might instead produce astounding examples of seeming confusion, such as this one found in the *Physiognomonics*: ἐπὶ δὲ τῆς φωνῆς ἡ μὲν βαρεία καὶ ἐπιτεινομένη ἀνδρεῖον, ἡ δὲ ὀξεῖα καὶ ἀνειμένη δειλόν (“In the matter of voice, the deep and tightened indicates manliness, the high and relaxed cowardice”) (806b26–27).⁷ Obviously the author was untouched by the astute definitions of his colleague Aristoxenus, who makes ἐπίτασις and ἄνεσις the technical terms for pitch movement towards the higher and lower region respectively, doubtless relying on age-old lyre-player experience.⁸ Instead, he appears to associate those notions with volume rather than pitch, drawing immediately on a speaker’s experience, while breaking free of string-related ideas. However, the rift between the mainstream physical explanation of pitch and its potential ethical application went deeper than could be mended in such a way: σύντονος had acquired the musical meaning of “high pitch,”⁹ and in Plato’s *Republic* a musical mode called συντονολυδιστί, “tense Lydian,” is condemned by Socrates for its association with lament, which proves its being unfit for use by men or even women of proper disposition (398e).¹⁰ As a result, possible associations were used in a highly eclectic way, with potential contradictions between individual applications of the same overall framework.

6 *Aud.* 800b25–26; Thphr. fr. 716.57–58 FHS&G.

7 Cf. 807a21–25: ἐν τῷ τὴν μὲν ἑρρωμένην ἀνδρείου τὴν δὲ ἀνειμένην καὶ ἀσθενῆ δειλοῦ ὑποληπτέον.

8 Cf. Krispijn’s (1990) restoration, now accepted by most experts, of a colophon *nusuh[um]* “tightening” following the section of upwards retunings of a stringed instrument in the cuneiform “retuning text” UET VII 74 from the earlier second millennium BC—currently, it seems, the first linguistic evidence for this procedure.

9 E.g. Arist. *Pol.* 1342b20–23.

10 Cf. Arist. *GA* 786b34–787a1 καὶ δοκεῖ γενναιοτέρας εἶναι φύσεως ἡ βαρυφωνία, καὶ ἐν τοῖς μέλεσι τὸ βαρὺ τῶν συντόνων βέλτιον “and it seems that low voice is a sign of a nobler nature, and in vocal compositions low pitch is better than the high pitched (σύντονα) ones”, and *Pol.* 1342a22–25: ὥσπερ αὐτῶν αἱ ψυχαὶ παρεστραμμέναι τῆς κατὰ φύσιν ἕξεως, οὕτω καὶ τῶν ἁρμονιῶν παρεκβάσεις εἰσὶ καὶ τῶν μελῶν τὰ σύντονα καὶ παρακεχρωσμένα... “just as the souls of such people are altered from their natural disposition, there are deviations from the scales and melodies that are tense (σύντονα) and deviantly coloured...”

At any rate, the *Problems*, even though sometimes operating with different concepts, never question a straightforward association of speed and pitch, and often state it explicitly: ὁξὺ μὲν ἐν ψόφῳ τὸ ταχύ, βαρὺ δὲ τὸ βραδύ (11.6.899a26).¹¹ Also, they cannot possibly doubt the fact that higher speed is generated by greater forces, other factors being equal. When tackling the mentioned conundrum that feebler creatures such as children or ill people emit higher sounds, they generally follow a path that is most lucidly expounded in Aristotle's *GA* 786b7–788a22, though this text focuses on the converse observation that, unlike in most other species, young and female cattle sound lower than adult males. Necessarily, Aristotle's argument must rest on the contention that other factors are not equal after all. Differently from Archytas' most influential treatment, in which the concepts of pitch and volume seem to become curiously entangled,¹² Aristotle separates them as neatly as Plato had done: while

11 Arist. *DA* 420a31–33 denies the identity of the concepts: οὐ δὴ ταχύ τὸ ὁξύ, τὸ δὲ βαρὺ βραδύ, ἀλλὰ γίνεται τοῦ μὲν διὰ τὸ τάχος ἢ κίνησις τοιαύτη, τοῦ δὲ διὰ βραδυτήτα “it is not the case that high pitch is fast and low pitch slow, but the particular kinds of movement are caused by fast and slow speed respectively.” The careful distinction is here motivated by the focus on perception rather than the physical properties of sound, but cf. the likewise cautious phrasing in *GA* 786b25–27: ἐπεὶ δὲ βαρὺ μὲν ἐστὶν ἐν τῷ βραδείαν εἶναι τὴν κίνησιν, ὁξὺ δ' ἐν τῷ ταχείαν. . . .

12 It has often been stated that Archytas couples pitch and volume as if they were but different aspects of the same phenomenon, whose physical cause is force/speed/impulse. Barker (2002) rightly points out how surprising such an “error” would be in a man of Archytas' intellect and seeks to mitigate the affair by having him succumb to the shortcomings of pre-scientific language, which provided no purely pitch-related adjectives, while the term ὁξύς included vigour with high pitch. For all the undeniable truth in Barker's principles, for the following reasons I doubt that such an explanation works out. Firstly, the very fact that Archytas explicitly and meticulously couples the words that (at least later) refer to volume and pitch respectively (μέγα φθέγγασθαι καὶ ὁξύ . . . μεγάλη τε εἶμεν καὶ ὁξέα . . . μικρά τε καὶ βαρέα) indicates that he did *not* regard the semantics of the former to be included within the latter. Secondly, even if it were granted that the “pungent” associations of ὁξύς implied a connotation of considerable volume in the auditory sphere, this could have given rise to the supposed “Archytan” model only if, conversely, the auditory associations of βαρύς would have included softness or at least been neutral as regards volume. The contrary seems to be true: texts preceding Archytas regularly associate the term with Zeus' thunder and the roaring sea or lions, but never, as far as I see, with a weak sound. By contrast, finally, the notion of ὁξύς may very well be found qualifying a sound that is notoriously conceived as outstanding neither for its loudness nor its piercing shrillness but its sweet musical beauty, as in *Soph. Tr.* 963 ὁξύφωνος ὡς ἀηδῶν “high-voiced as a nightingale”; cf. also *Telestes*, fr. 6 *PMG* ap. *Ath.* 626a ὁξύφωνοις πηκτίδων ψαλμοῖς “high-voiced harp-plucking”. Accordingly, *Theophrastus*, fr. 716.80–85 *FHS&G*, concedes greater conspicuousness to high pitch, but not greater force. Also, the lack of precise sound-related adjectives noted by Barker may be overstated due to

the association of pitch with speed remains uncontested, volume is related to the amount of air set into motion—which is, by the way, much the same image as underlies the English term “volume.” Since, it appears to be granted, the same force might be used to set a smaller amount of air in quicker motion or a larger amount in slower motion, the difference between cattle and other animals is sought within the nature of their vocal tracts: cattle have some kind of wide cavity, whence the amount of air is always great, which is why the feeble individuals succeed only to move it slowly and therefore produce a lower pitch, while it takes the vigour of bulls to accelerate the same amount of matter more. So far, the argument appears successful; on second thought, however, it seems to prove only what would not have called for an argument at all, since a theory relating pitch to speed or force would have lead us anyway to expect roaring bulls to sound higher than mooing calves. When applied to the actual problem, the argument is hardly useful. In fact the author disguises the dilemma by defining other animals’ vocal tracts as εὐταμίετον (GA 787b5), which probably means that the amount of air dispensed can be readily adjusted. This evidently raises the question why in all those animals, including human beings, adult males would normally decide to move more air more slowly instead of less air faster. I am not sure that it is possible to find an answer based on the premises established by the text that does not run contrary to all evidence; anyway, the model itself would not stand a minute of scrutiny. For instance, while many may agree that even very small children may produce significant measures of relatively high-pitched loudness, they are rarely found uttering bass notes; Aristotle’s theory, by contrast, does not seem to prohibit them from singing as low pitches as anybody else, just by applying less force; their restricted body size would only prevent them from becoming all too loud. The sequel in *Generation of Animals* adds to the confusion by likening the testicles and spermatic ducts to weights attached to a string, and the effect of emasculation on the voice to that of removing the weight from a string on its pitch. Even though

the largely poetic nature of the extant sources. It is hardly conceivable that prior to the Peripatos musicians and instrument makers did not have means of discussing an instrument’s timbre other than Homeric language, of communicating the fact that a string or finger hole was out of pitch and in which direction so, or of asking a chorus member to sing more loudly or more softly. *De audibilibus*, at least, appears to search for explanations for the physical causes of aspects of sound denoted by long-established adjectives rather than to define such terms. After all, Modern English does not seem to possess more non-metaphorical, primarily-acoustical adjectives for properties of sound than Classical Greek did. Personally, I think Archytas can be excused on different grounds; but for the present purpose the foregoing arguments will suffice to indicate that, even at the start of the fourth century, Greek language on sound may have been less confusing than is sometimes believed.

the idea of tautness producing higher pitches had just been adduced for the case of the bulls, the author, while considering the effects of adolescence and castration, now meticulously avoids mentioning the fact that a string with added attached weight becomes higher while men with maturing testicles become deep-voiced, an effect counteracted by their removal.¹³ The contrast between the image of the string and the facts it supposedly explains is entirely perplexing—who would invoke an example that is so evidently improper? The author seems to be caught in the dangerous swamps of contrary meanings attached to the ideas of tension and relaxation, which are gendered not according to any system but by attaching to the feminine side, including children, the old, and sick people, whatever appears less desirable in the present context. For instance, when reading the following passage—

ἀφαιρουμένων δὲ τῶν ὄρχεων ἀνίεται ἡ κατάτασις τῶν πόρων ὥσπερ ἀπὸ τῆς χορδῆς καὶ τοῦ στήμονος ἀφαιρουμένου τοῦ βάρους... διὰ μὲν οὖν ταύτην τὴν αἰτίαν τὰ ἐκτεμνόμενα μεταβάλλει εἰς τὸ θῆλυ τὴν τε φωνὴν καὶ τὴν ἄλλην μορφήν διὰ τὸ συμβαίνειν ἀνίσθαι τὴν ἀρχὴν ἐξ ἧς ὑπάρχει τῷ σώματι ἡ συντονία...

With the removal of the testicles the disposition of the [spermatic] ducts is relaxed (ἀνίεται), just as when the weight is removed from the string or the thread on the loom... and it is for the following reason that the castrated change both voice and body shape in the direction of the female: it happens that the cause on which the tautness (συντονία) of the body depends is relaxed.... (788a3–9)

—we appear to encounter but a very general notion of female lack of tension (συντονία)—a notion that manages to remain unrelated to the fact that it is precisely “tense” melodies (σύντονα) that only briefly before had been negatively contrasted to manly low pitch (βαρυφωνία) (786b35–787a1). The contradictions that linger everywhere are at least spelled out in *Pr.* 19.37, whose author is nonetheless content with accepting that high pitch in children is due to their weakness, while high pitch in singers is a token of power, and that we are somehow obliged to focus on mass in the former case, but on speed in the latter.

13 In *Pr.* 11.34, the testicles are mentioned in a similar context for a different reason: as an example of the growth of ducts during adolescence.

In general, the chapters in *Pr.* 11 do little to resolve these conflicts and clean up the conceptual mess. *Pr.* 11.3 is one of the few to address matters of volume at all, presupposing the aforementioned explanation based on the quantity of moving air. *Pr.* 11.13, when applying the general models to people weeping and laughing, promotes several arguments of very different quality, if the transmitted text is even remotely correct. Its central part, which rests on a ballistic conception of sound, makes the most straightforward and convincing case, arguing that a weeping body is tense (σύντονος) and therefore emits higher pitches.¹⁴ Both before and afterwards, however, the notion of quantity of air is involved. What role it is supposed to play in the first case is not entirely clear; but we need not restate possible solutions here. Towards the end a straightforward line is drawn from the notion of mass to slow motion, which appears to represent a sort of unjustified shortcut through the argument of *GA*, from whose line of thought the question of the shape of the vocal duct is omitted. In this way, a system is formed in which anything may be proven: if something that is perceived as weak emits a low pitch, this is—straightforwardly—because it is unable to accelerate the air more; if it produces a high pitch, this is—less straightforwardly—because it moves only a little air, which “therefore” travels fast.¹⁵ Apparently it never occurs to the writers to test the model by means of the criterion of respective loudness,¹⁶ which would lead one to expect that a voice whose high pitch is explained by the producer’s weakness is less intense than one whose high pitch is allegedly due to greater force.¹⁷ Instead, other factors may be considered. In *Pr.* 11.13, for instance, heat also comes into view: laughing people are perceived as warmer than weeping people, whence more

14 Cf. *Pr.* 11.50, where σύντονος seemingly does not involve any notion of intrinsic energy. The ballistic conception is especially prominent in 11.52.

15 Cf., as an extreme example, *Pr.* 11.40, where the associative template “weak → moves little air → fast → high-pitched” appears automatically applied to a question (which is concerned with a supposed particularity of men among animals) to which it does not in fact contribute anything.

16 This is perhaps most patent in *Pr.* 11.21, where the two contrasting explanations for high pitch are juxtaposed without further argumentative adornment.

17 This was clearly seen by the author of the recension on which the extant Arabic translation is based (cf. e.g. *PPA* 12.43, Filius (1999, 576–79), with *Pr.* 11.40), who consequently rewrote all the relevant arguments, practically eliminating the problematic idea that derives speed from paucity of mass. Along with it, speed theory in general is suppressed to such an extent that in 12.7 (the rendition of *Pr.* 11.6) speed appears associated not with pitch but with volume.

air is set in motion.¹⁸ The notion is supported by an observation from aulos playing: οἱ γὰρ θερμοὶ τῷ πνεύματι ἀλλοῦντες πολὺ βαρύτερον ἀλλοῦσιν (900a30–31). Mayhew (2011) translates this: “for those who play the *aulos* with hot breath play it much lower.” The translation, I think, is correct, but it does not seem to fit the Greek. As it stands, the text would either mean, if we take τῷ πνεύματι to qualify οἱ θερμοί, “for people who have hot breath, when playing the aulos, play the aulos much lower,” or, if we associate it with ἀλλοῦντες, “for hot people, when playing the aulos with their breath, play it much lower.” The latter option makes no sense at all, since there is little else with which one might play the aulos; the former is impossibly clumsy, since the participle ἀλλοῦντες would not add anything at all to the meaning: while it is unproblematic Greek to say ἀλλοῦντες . . . ἀλλοῦσιν if the participle is qualified, it is hardly possible to say so if it is not. Therefore I propose adjusting the text to the translation and read οἱ γὰρ θερμῷ τῷ πνεύματι ἀλλοῦντες, as is also suggested by the parallel in GA 788a20–21 (οἱ γὰρ θερμοτέρῳ τῷ πνεύματι χρώμενοι). This is by far preferable on another level as well: while it would be awkward to single out auletes of warmer and colder breath respectively, it is perfectly plausible to distinguish between different playing styles in such a way. In this case, “play with warmer/colder breath” might well have been advice commonly heard from aulos masters. It is not all too difficult to sort out what this might mean. The perceived temperature of breath is largely governed by lip tension: we warm our fingers by softly breathing on them with open, relaxed lips, while we cool down hot items by directing a stronger jet of air at them through a small opening between tense lips.¹⁹ Indeed, on a double reed instrument such as the aulos, relaxing the lips causes the reed to open up more, resulting in lower pitch, while squeezing it between them makes the sound higher.²⁰ As an aulos player, I think the difference feels similar enough to that of “breath temperature control” to warrant the use of a terminology such as that found in our passage.

18 Conversely, *Pr.* 11.14 attributes higher pitch to warmer (but smaller) individuals. Cf. also 11.3, 32, and 53.

19 Barker (1984, 83–84 n.61). However, the mouth cavity as invoked by Barker does not seem to explain the aulos example. In a discussion of Anaximenes’ account of the effect (fr. 1 DK = Plut. *De prim. frig.* [*Mor.* 947f]) and Aristotle’s evaluation of this account, the effect is ascribed to changes in lip tension (ἡ πνοὴ πιεσθεῖσα καὶ πυκνοθεῖσα τοῖς χεῖλεσιν, ἀνιμμένον δὲ τοῦ στόματος . . . συστρέψαντες τὰ χεῖλη).

20 The text’s πολὺ may seem exaggerated, since the effect hardly exceeds a semitone even on the highest finger holes, though in terms of playing together in an ensemble, this would in fact be quite a lot. Cf. *Aud.* 804a12–14: squeezing the reed makes the sound “higher and thinner” (ὀξυτέρα . . . καὶ λεπτοτέρα); in 801b37–40, however, the effect of the same action is described as “harder and brighter” (σκληροτέρα καὶ λαμπροτέρα).

I have allowed myself this small digression because the same concept had already been stated with slightly greater precision in *GA*, and because there the notions of pitch and temperature had been associated by means of the notion of density, which, in a slightly different guise, will concern us below. Warmer air, Aristotle claims, produces a lower pitch because of its thickness (παχύτης), but colder air produces a higher pitch because of its tenuity²¹ (λεπτότης). Although it is expressed more clearly in the *Problems* than in *GA*, once again the idea of greater mass moving more slowly stands behind this passage, in connection with a notion of “thin” voices which is explained at greater length in the treatise called *De audibilibus*.²²

Similar thoughts underlie much of *Pr.* 11.6, the Problem I want to focus on especially. At first glance, it is noteworthy in that the author is not sure whether the phenomenon he sets out to explain is even real: “Why is it that voices heard from far away appear higher in pitch?” Curiously, the stated fact is not based on examination of voices heard from far at all, but on the observation that “at any rate those who imitate people shouting from very far away utter higher sounds.” Where is it, we might ask, that imitations of wide-range shouting were generally encountered in ancient Greece? Rather than the occasional raconteur one might think of epic recitation or drama, which are more likely to give rise to a manner of representation that would be recognised as typical. More importantly, we must wonder about the nature of the perceived pitch alteration. At first, and in line with the usual understanding of pitch in the ancient sources, one would probably think about a change of basic frequency, shifting the entire contour of speech melody to a higher range, as if transposing a piece

21 Though the term may be unfamiliar, I have found no better candidate for translating all aspects of λεπτότης that are relevant in our context. Cf. <http://www.merriam-webster.com/dictionary/tenuity> (last accessed Jan 27th 2014): “1: lack of substance or strength 2: lack of thickness: slenderness, thinness 3: lack of density: rarefied quality or state”, which are all echoed in the *Problems*, and the acoustical association with something close to the notion of ὀξύτης in Nathaniel Hawthorne’s description of Elizabeth Barrett Browning: “a shrill yet sweet tenuity of voice” (*Passages from the French and Italian Note-Books of Nathaniel Hawthorne*, edited by S. Hawthorne. Boston 1883, 294).

22 803b18–26. In the context of the *Generation of Animals* and the *Problems*, the passage from *De audibilibus* is remarkable for the fact that any mention of pitch is avoided, even though “a small amount of emitted breath” is given as the physical cause for thin voices and though these are attributed to children, women, castrates and ill or fatigued people, both of which notions are so often associated with high pitch in the other works. Instead, the passage evokes notions of low volume, perhaps paired with a particular timbre.

of music. However, the text continues by likening the imitating voices to those of an echo—"the sound of an echo also appears higher."²³

Independently of the author's understanding of possible pitch shifts, a phenomenon such as that referred to here is definitely distinct from the "transposing" type. No echo of a pitched sound such as the human voice can change this sound's basic frequency (unless moving objects are involved, an option that we may safely exclude for ancient observations of echo effects). However, sounds usually consist of components that are distributed over a wide frequency spectrum, and which consequently may suffer quite different fates while travelling and being reflected. In many environments higher components may remain more focused, while low ones get diffracted.²⁴ In such a case, the echo would in fact *sound higher* than the original voice as perceived close to the emitter; however, it would do so in a very different way than, say, the note of *g* sounds higher than *d* a fourth below. The fact that the echo is quoted in order to clarify the nature of the perceived sound shift of course does not prove that the author is indeed talking about a similar kind of pitch shift as may occur in echoes. However, it must clearly caution us from rashly presuming that he had the "transposing" type in mind. As regards the imitation of the supposed natural effect, we may also entertain both options about how it was achieved, since the two types of pitch alteration are not readily distinguished by uninformed perception: it may have been done either by raising the basic frequency of the voice, or perhaps by altering its formants so as to favour the higher partials, or both.²⁵

The author substantiates the observed similarity of sound between echoes and imitations of remote voices by associating the former with the notion of remoteness, evidently because here the sound travels twice the distance between emitter/receiver and reflector. Next he phrases a counterargument, from which it would be expected that remote sources are heard at a lower pitch. It is based on flawed Aristotelian ballistics, which attributes the downward trend of trajectories to loss of speed. This argument is not pursued further; evidently it still belongs to the exposition of the problem, elevating it to the state of a real conundrum.

23 Cf. *Pr.* 19.11. I do not think Jan (1895, 61 and 84) is justified in demanding the sense of "those imitating the sound of an echo."

24 This principle is already stated by Theophrastus; see below, n. 32.

25 In phonetics, "formants" are a way of describing the filtering process that takes place in the vocal organs and is responsible for the specific timbre of the emitted sound, by enhancing certain parts of the sound spectrum while suppressing others.

In the sequel, more than one solution is pondered. The first is based on a seemingly direct association between volume and pitch in performance: striving to imitate a “feeble and thin” voice (ἀμενηνῇ καὶ λεπτῇ), the imitators are bound to sound high as well, just because low voices do not share these characteristics. At first this may seem to confuse pitch and volume; however, if we think in terms of timbre more than volume, the author may probably be excused. Here the question of what was the context in which the observation took place is especially vital. If it was public performance, then imitation of far-off voices achieved by lowering the volume would make no sense, as it would doubtless jeopardise audibility. Therefore an actor or rhapsode would have had to resort to basic frequency and/or formant control, while maintaining a normal level of loudness. Either technique would likely have been perceived as “using a higher voice,” as our text presupposes. In this case—and the author seems to be very much aware of the fact—imitation would have been achieved by factors that *differ* from those inherent in the imitated phenomenon. As we have seen, this difference may be explained on the basis of performance requirements.

The possibility that imitation is actually achieved by means of the same factors that are involved in the natural phenomenon is considered only in a second moment. A lengthy explanation is offered regarding how this would work, including a description of sound propagation in general. However, it is not at all easy to see what is the supposed mechanism to which the perceived pitch alteration is actually attributed. Back in 1989, Andrew Barker interpreted it as follows:

The author apparently means that as the movement travels it is dispersed (see the end of the passage), so that an initially broad and unified continuum of movement is fragmented into many “thin” ones travelling in different directions, and each branching in turn. Then any one stream of movement is thinner the further it is from the source, and so, on the present theory, will move more rapidly. (1989, 87 n. 10)

This model evidently implies that sound *accelerates* in time, even though it eventually loses all inherent energy. I do not deny that such an interpretation is possible given the *Problems*’ general admittance of confused notions. Nevertheless, I wonder whether the text might be reconciled with a more intuitively appealing model, all the more because I think that the quoted interpretation is also not entirely plausible on structural and perhaps linguistic grounds. But let us start with inspecting the internal plausibility of such a

model, especially within the context of Book 11. Firstly, the idea of acceleration is hardly reconcilable with that of final exhaustion of internal energy: who would conceptualise something suddenly running out of energy which has up to then steadily become faster and faster? However, one might have argued for acceleration by attributing the virtual loss of sound at a large distance not to exhaustion of energy but to dilution below the threshold of perception—in the framework of Barker's explanation, by breaking up into streams of movement which may be quite fast, but are too thin to make an impression on the hearing. I cannot see what would have prevented the author from adopting such an explanation, if acceleration was what he wanted. Instead, he is adamant on presuming complete exhaustion: "...until [the sound] dies away—which is the same thing as falling in the case of bodies—as soon as the air is no longer able to push, in the latter case, the missile, and in the former case, the air."

Secondly, *Pr.* 11.19 and 20, though resonating closely with 6, clearly do not consider acceleration. The two are comparatively short; 20 provides much less thorough reflections on the same question as 6, while 19 wonders about the closely related question why lower-pitched voices are less audible from far away. Both arguments are based on the concept of tenuity in the guise of thinness, but when it comes to relating thinness to speed, they do so in very different ways.

In the case of 20, thinness is opposed to speed as another, apparently independent, cause for high pitch. This opens up the way of explaining the supposed higher pitch of remote voices by thinness *alone*, separately from any consideration of changes in speed. Might we relate such a distinction to the difference we have discussed above, between perceived "higher pitch" as established by a higher base frequency ($\delta\acute{\xi}\acute{\upsilon}\tau\eta\varsigma < \tau\alpha\chi\upsilon\tau\acute{\eta}\varsigma$), as opposed to a relative dearth of lower partials ($\lambda\epsilon\pi\tau\acute{o}\tau\eta\varsigma$)? In any case, the author of 20 seems to prefer breaking up a unified theory of pitch to assuming an acceleration of sound over time.

Similar conundrums are not encountered in 11.19, since this Problem is not concerned with a change of pitch. Consequently, thinness and speed can appear side by side. The former concept is employed in an entirely naïve way: "thin" sound reaches further because thin objects are long. Speed, in turn, is viewed as a potential additional explanation, since a thin (stream of air) is more easily moved.²⁶ On top of this, the number-of-impacts theory of sound

26 This is also argued in *Pr.* 11.16, a variant of the standard explanation for children's, women's, and old men's high voices with special focus on tenuity, including the straightforward statement that "a thin voice is high."

also creeps in; but this aspect need not concern us here. Instead, we will consider the argument's first part in more detail, because its translation involves a pitfall that will also be essential for the interpretation of *Pr.* 11.6 below:

ἢ διότι ἡ βαρυτέρα φωνὴ πλείω μὲν ἀέρα κινεῖ, οὐκ εἰς μῆκος δέ; πόρρωθεν μὲν οὖν ἦττον ἀκούομεν, διότι ἐπ' ἔλαττον κινεῖται, ἐγγύθεν δὲ μᾶλλον, διότι πλείων ἡμῖν ἀήρ πρὸς τὸ αἰσθητήριον προσπίπτει. (901a8–11)

Is it because the lower-pitched voice moves more air, but not to a long distance? Consequently we hear less from afar, because it moves less strongly, but more from nearby, because it is a larger amount of air that strikes our organ of perception.

The focus on distance here has led translators to understand the phrase ἐπ' ἔλαττον in a spatial sense, “since it is moved less far,” as more or less but a stylistic variant of οὐκ εἰς μῆκος. However, as far as I see, ἐπ' ἔλαττον does not carry a spatial association per se. The expression is widely used as an adverb of ἐλάττων, thus becoming the comparative form of ἐπ' ὀλίγον as well as the opposite of ἐπὶ πλεόν, bearing a very generic sense (“to a smaller degree”).²⁷ A closer look at the argument confirms this: while a translation involving the notion of “moving less far” implies the complete evanescence of low sounds beyond the distance in focus, the Problem is actually formulated in terms of hearing better (μᾶλλον) and less well (ἦττον), without questioning the fact of perceptibility (ἐξακούεται) as such.

A related question, namely “why high-pitched sounds are heard across a larger distance than low-pitched sounds are,” may follow logically from that which is actually posed; in fact the principle that is stated first, and on which the explanation is based, may seem to assume so (“moves . . . not to a long distance”). However, in the face of the sequel, even the expression οὐκ εἰς μῆκος should perhaps be understood along a similar vein as “moves . . . without a strong longitudinal component.” Anyway, this is only the basis of the explanation, not the explanation itself. Therefore the next sentence brings us back to the envisaged situation, which, albeit perhaps imaginary, clearly involves sounds that are heard and compared in intensity. Here it would be more than imprecise to explain the fact that “we hear *less*” by referring to the notion that “the sound does not travel that far”. Only an accurate translation restores the full logic to the argument: low-pitched sounds do not have a similar degree of longitudinal directedness as high-pitched ones; therefore we perceive them

27 Cf., among innumerable passages, *Pl. Phd.* 93b; also, Smyth, *Greek Grammar*, §1689.3.c.

less strongly (ῥῆτον) from a distance, because the movement of the air is less intense (ἐπ' ἑλαττον).²⁸

All in all, here we are presented with an exquisite mix of sound theories that were floating around the minds of late Classical and post-Classical thinkers: besides the prevalent speed theory, a kind of shape theory makes itself heard no less than ideas based on mass and the quite evolved theory of impact frequency. What we have not found in this passage is the concept of acceleration; if anything, it is presumed that the movement of air that constitutes sound would decelerate over time.

So we return to *Pr.* 11.6. Apart from its conceptual isolation, the proposed interpretation by acceleration is also challenged by the structure of the argument: such a reading of the main part requires the notion of dispersion into smaller and smaller streams, which is only stated towards the end of the text. Therefore it would be outright impossible to understand the argument on a first reading. However, the main part does include a detailed discussion of the physics of sound propagation—but without any hint at the supposed dispersion theory. Maintaining the acceleration interpretation, therefore, appears to require the assumption that the author first composed an explanation which left out the essential bit, and once noticing this added the core of the argument only as an afterthought. But such a notion, even if it were regarded as possible, is not supported by the way in which that “afterthought” is actually introduced. There the concept of dispersion is explicitly intended to explain the facts “that to those nearby it is not obvious that the sound becomes lower or higher, and generally that it does not behave in a similar way as do weights that are thrown.” Even though the latter statement might appear general enough, it must be significant that this general consideration is introduced only in a second moment—which is hardly conceivable if the passage was meant to supply the basis for understanding the whole argument. It rather looks like an afterthought owed to the recognition that, while the effect of pitch shift from a greater distance may be regarded as sufficiently explained, its absence at a closer distance still needs to be addressed in order to give a full explanation. So much can be gleaned from how the “afterthought” is introduced; the details, by contrast, appear very obscure. Why is an inverse pitch shift envisaged at all?

28 Andrew Barker alerts me to the potentially contradictory explanations by intensity of motion for distant sounds on the one hand, and by amount of air for near sounds on the other. I think the contradiction is at least mitigated if we interpret the underlying concept of “intensity of motion” as being close not so much to our notion of speed, but to that of impulse, which depends also on the mass of the moving object.

And how would the notion of diffused propagation explain its absence? At any rate, I cannot picture how this might presumably work out on the basis of an acceleration theory.

Finally, I am also unable to see how the acceleration hypothesis might be comfortably reconciled with the author's conviction, stated between the main argument and the afterthought, that the given explanation is essentially analogous to that concerning the high voices of children and ill people. Though variants of that question are discussed over and over again, acceleration never plays a role: the higher speed of a lower mass is always envisaged to be created at the start, together with the sound.

So we must finally turn to the core of the main argument, where the author sets out to explain the alleged upwards pitch shift occurring at some distance. The actual explanation is preceded by a meticulous description of the mechanism of sound propagation, and how it differs from the movement of a missile. It is introduced by the phrase αἴτιον δὲ ὅτι ὁ ἀήρ ὁ φερόμενος ποιεῖ τὸν ψόφον ("the reason is that it is the moving air that produces the sound"), which signals, in combination with the following description, that the explanation will be found in the particular properties of this kind of movement (as opposed to the movement of solid bodies through the air). Presumably this contrast, which pervades much of the text including the afterthought, is exploited because a moving body is generally expected to maintain its properties; therefore the modification of a property of a moving entity is put down to the fact that this entity is not a body, and what moves is not a substance. Instead, the coherence of the phenomenon is warranted by continuous propagation of movement from "one air" to "the next."²⁹ This is all very clear, but regarding the underlying question, it is only preparatory. The real argument is reduced to a single sentence, which is immediately followed by the concluding statement to the effect that the proof is considered complete, and then a brief notice that supplements a proposition that this proof had used implicitly: καὶ πρῶτον ἐλάττω θάπτον μὲν κινεῖται, ἐπ' ὀλίγον δέ. διὸ πόρρω δξύτεραι καὶ λεπτότεραι αἱ φωναί. τὸ γὰρ θάπτον δξύ, ὥσπερ καὶ διηπόρηται. The first sentence will need detailed

29 I think we need to excise the second article in ἡ μὲν γὰρ φωνὴ γίνεται [ἡ] συνεχὴς ἀέρος ὠθουμένου ὑπ' ἀέρος, both improving the style and rescuing the sense: "sound becomes continuous because air is always pushed by air" (so also Mayhew's translation, in spite of his text) instead of "the continuous sound is created when air is always pushed by air." The latter makes no sense since the present argument is not concerned with the continuity of sound over time, as opposed to brief or intermittent sound, but with the continuity of transmission of (however brief) a sound.

discussion, since almost every word in it is problematic.³⁰ The rest is readily translated: “Therefore voices are higher and thinner from afar. For high pitch is related to greater speed—a question we have already treated.”

So what is it that justifies the author’s “therefore”? Πρῶτον (“at first”) might qualify either ἐλάττω (“what is at first smaller/less”) or the entire sentence. Since an increase of mass seems out of the question, it must be the latter. Ἐλάττω might mean “something rather small” or “a smaller part,” or “less.” With regard to ἐπ’ ὀλίγον, finally, much the same holds true as has been established above about ἐπ’ ἔλαττον: although some translators have taken it to mean “over a short(er) distance” or “for a short time,” its basic sense is something like “not much.”³¹ Again, this correct sense is clearly required by the argument: if the thing that travels fast does not travel far, while pitch is associated with speed, then the obvious conclusion would be exactly contrary to what is intended. The argument therefore appears to presuppose that being faster also means travelling further—this is an intuitive assumption, and I do not see in what other way the implied connection between the notions of speed (θᾶττον) and distance (πόρρω) might be construed.

In any case, ἐπ’ ὀλίγον unambiguously qualifies κινεῖται and would therefore most naturally describe some kind of intensity of the sound’s motion. This is however set in opposition to its speed (θᾶττον μὲν . . . ἐπ’ ὀλίγον δέ). Both these supposed physical aspects are addressed in the conclusion: the voices are perceived as ὀξύτεραι (“higher”), because the movement is faster, but at the same time as λεπτότεραι (“thinner”), because it is less vigorous. The reason for this lack of intensity in spite of higher speed must be sought in the term ἐλάττω: since a smaller quantity of moving substance is involved, the resulting sound is not perceived as full. Thus the sentence might be translated roughly as follows: “And at first a smaller part moves faster, though not very strongly.”

So far I have tried to establish aspects of what the text of *Pr.* 11.6 ought to intend to say, assuming that its author was not completely careless or crazy, either failing to notice that the argument backfires or losing sight of the

30 Jan (1895, 62) suggested changing πρῶτον ἐλάττω to πρὸ τοῦ λήγειν, attributing to the author the notion that a missile is (especially?!) fast at the moment when it hits the ground. I cannot see how such a view might even accommodate the comparative θᾶττον.

31 Cf. e.g. Arist. *DA* 420a30–31: τὸ μὲν γὰρ ὅξυ κινεῖ τὴν αἴσθησιν ἐν ὀλίγῳ χρόνῳ ἐπὶ πολὺ, τὸ δὲ βαρὺ ἐν πολλῷ ἐπ’ ὀλίγον. Generally, for actions that may differ in intensity, ἐπ’ ὀλίγον usually refers to intensity; if there is no possible difference in intensity per unit of time, it specifies duration. Applied to movements, lack of intensity may of course *imply* a shorter distance, if the verb carries the notion of *directed* movement (cf. ἐπὶ πλεόν φέρεται in *Pr.* 11.47.904b10). Correctly Jan (1895, 62): *paulisper*.

question he was trying to answer. Regarding the first possibility, his careful and lucid exposition of the physics of sound propagation makes me quite confident that he would have noticed an all too blatant contradiction. The second option is less easily dismissed: if we assume that the idea of pitch alteration momentarily escaped the writer's mind, he might inadvertently have given an answer to the much easier question of "why do higher pitches carry further?"—namely, because small things travel faster. However, since the next sentence restates exactly the original question, such a slip of mind seems rather unlikely. Moreover, the notion of "smallness" would turn up without any motivation. Finally, and probably most importantly, such an answer would not have required the whole excursus on propagation physics at all. On balance, it seems likely that the author wanted to say pretty much what we have established: that the low-pitched bulk of a sound does not travel as far as the small and therefore fast and high-pitched parts.

If this is true, there is a bit more to it than we find in other Peripatetic reflections on sound, even though little of it is developed further or even expressed. If indeed the given model entails that a small part of the original voice is fast enough to travel further, while a slower mass is mostly perceptible in the vicinity of the source, the latter being responsible for the lower pitch that dominates there, the former for the higher pitch heard further away, this means that sound is conceptualised as consisting of components. These components effectively carry different pitches, and would correspond to a sort of components of the original sound-producing event, perhaps associated with moving masses of different sizes. Such a theory would appear quite modern, not unlike an analysis of sound spectra. Are we happy to attribute such a conception to an ancient author? And is it a good idea to derive such an edifice of thought mostly from a single sentence?

I would tend to answer those questions negatively—were it not for the fact that the suggested interpretation may also shed light on the obscure sentences that I have termed above the "afterthought." This "afterthought" is separated from the preceding conclusion by the observation that the established explanation draws on the same cause that is also responsible for the fact that children and ill people sound higher than adult men and healthy folk. We have discussed the accepted Peripatetic explanation for this above; apparently the parallel noticed by the author involves the association of a larger quantity of air, low pitch and some perceptual combination of higher volume and fuller timbre on the one hand, and a smaller quantity of air, high pitch, and a feeble sound on the other. This is immediately followed by the "afterthought": the author finds it necessary to establish a reason why no pitch shift is experienced close to the source of sound, and links this with another clarification about

the general dissimilarity of sound propagation and the movement of a missile. It is clear enough what this difference is—the missile has a single point of impact while sound strikes everything around, and, again, in the case of sound it is only the impulse that moves through space, not an actual projectile of air. However, it is not so easy to establish how this difference would bear on the question why nearby listeners do not perceive pitch shifts, and even less so why, suddenly, a downward shift is even envisaged as an option that needs to be excluded.

However, once we are prepared to accept that the author was imagining sound as being composed of various components, the question makes sense: in such a scenario one might expect that a listener who is close to the source of the sound perceives it sometimes as higher-pitched, sometimes as lower, depending on which of those components happen to hit her ear. However, our author argues, this is not the case because all these components experience that strong diffraction that is typical of sound, so that in the vicinity of the source they will all reach all points.³² Only when the lower components have trailed off, at some distance, will the compound nature of sound have a noticeable effect.

I can see no other explanation that makes satisfactory sense of *Pr.* 11.6, as it stands. Other options would reduce it not so much to a slightly garbled piece of mildly confused reasoning—something we do not find very problematic in the field of *Problems* studies—but effectively to a completely nonsensical whole that happens to contain quite intelligent points in detail.

What remains puzzling is the fact that the principle on which the present explanation is grounded is not explicitly stated. Would the author have taken

32 The concept resonates with the principle stated by Theophrastus, fr. 716.88–100 FHS&G: ... ἐπειδὴ ὁ μὲν ὀξύς ἦχος πρόσω μάλλον φέρεται καὶ ἄνω ὁ δὲ βαρὺς περίξ κατ' ἴσον μάλλον. ... εἰς πᾶν γὰρ ὁ βαρὺς φθόγγος διικνεῖται περίξ, ὁ δὲ ὀξύς πρόσω ἢ εἰς ὃ βιάζεται ὁ φθεγγόμενος ("... since a higher timbre moves rather forward and upwards, but a lower rather everywhere around in an even manner. ... A low note arrives at every place around, but a high one straight ahead or wherever the emitter compels it to go"). Starting from this principle, it would have been possible to give straightforward reasons for variations of *Pr.* 11.6: when evaluating *directed* voices, higher ones would be perceptible at a greater distance; or, embracing the idea of components of sound, a voice *directed* at a particular listener would sound higher at some distance once the lower components are reduced by diffraction in all other directions—which might have amounted to a correct explanation of an actual phenomenon. However, though Theophrastus' comment proves that respective ideas were current in Peripatetic circles, his focus is on disproving a quantifiable nature of pitch, which makes his approach incompatible with the physical framework adopted in the *Problems*.

it for granted? If so, he can hardly be excused for making his reasoning so difficult to follow: after all, our sources do not convey the impression that the idea of sound consisting of components belonged to the clichés of Peripatetic physics. On the other hand, I think it is indeed possible to trace down similar thoughts in other texts. Even more interestingly, also in these cases they are tacitly assumed rather than spelled out as principles.

Firstly, the notion of a mixture of sounds was of course familiar to ancient thinkers. Apart from the everyday experience of a multitude of different noises impinging themselves simultaneously on our hearing,³³ it is especially the intentional simultaneity of musical notes that attracted interest. Of special relevance is the observation that while discordant notes appear to maintain their individuality when played together, in the case of concords a pair of notes blends into something that is perceived as a single entity.³⁴ The proposed interpretation of *Pr.* 11.6 would entail an inverted notion: what is perceived as a single voice or even “note” may in fact comprise several components.³⁵

This is the stance that the author of *De audibilibus* seems to take, where the properties of certain sounds are explained as arising from interactions between more than one component (which may have taken different paths through a solid material). As Andrew Barker has argued convincingly, the idea of a component which is not identical with the full sound is generally associated here with the term ἦχος.³⁶ A likely cause for this terminology may have been the fact

33 Cf. *Aud.* 801b15–19 on mutual obscuration of sounds, leading for instance to reduced comprehensibility of texts uttered by several people at once.

34 The idea seems to appear as early as Archytas, to whom is ascribed the explicit notion that consonances are perceived as a single φθόγγος, a word that was to become the standard term for “musical note” (Porph. in *Ptol.*, p. 104.12–13 Düring: ἐνὸς φθόγγου γίνεσθαι κατὰ τὰς συμφωνίας τὴν ἀντίληψιν τῇ ἀκοῇ). For the late fourth century, cf. *Sect. can.* p. 149.17–24 Jan (τοὺς μὲν συμφώνους μίαν χρᾶσιν τὴν ἐξ ἀμφοῖν ποιοῦντας); *Aud.* 801b19–21; 803b40–804a8.

35 A related idea may have been pursued by the author of *Pr.* 19.42, whose first part seems to entertain the hypothesis that the decaying sound of a note might be perceived as dropping to the lower octave; cf. the notes in Barker (1989, 96). This would amount to the recognition of subharmonics as (at least psychological) components of a sound.

36 Barker, “On *De audibilibus* 801b–803b,” an unpublished lecture delivered at the Seminar on Ancient Greek Music at the Ionian University, Corfu, July 2009, writes: “where the notion of a mixture of sounds or the modification of one sound by another is in play, when both the ingredients disappear in the mixture they are both called ἦχοι, and when there is one dominant element and the other modifies it . . . only the dominant sound is called a φωνή or a φθόγγος, and the modifying element is always called an ἦχος. . . we have seen that in at least the great majority of cases the word ἦχος is not used interchangeably with nouns such as φωνή and φθόγγος, and in particular that it is used in a special way in cases where the sound that arrives at our ears is made up from two different acoustic

that the empirical basis for the notion of such components was the tactile perception of vibrations in sound-generating objects,³⁷ which chimed in with the semantic field of ἤχος, a term associated particularly with resonance, reverberation and sympathetic vibration. Once more, the details need not concern us. What is important is that the author of *De audibilibus* bases his arguments on the assumption that a single sound or voice (φωνή/φθόγγος) is often composed from more than one element, while he does not regard it as necessary to discuss or explain this assumption. In fact such composite voices are conceived analogously to simultaneous sounds, such as the consonances.³⁸

The main difference between the arguments of *De audibilibus* and *Pr.* 11.6 is that the latter appears to allow for differently pitched components of a single voice, while the former applies the principle mainly to matters of timbre, in accordance with its focus on different qualities of sounds—though still acknowledging that more or less the same mechanism is at work when different pitches blend into a single experience. The proximity of concepts between the treatise and *Pr.* 11.6 is not surprising, given that the works share other aspects of sound physics as well. In *De audibilibus* it is not only taken for granted that pitch is caused by speed, but the transmission of sound is described by the familiar phrase of ἀεὶ γὰρ ὁ ἕτερος ἀπὸ τὸν ἕτερον κινῶν (“always one air moving the other”) (803b29–30), and the notions of “high” and “thin” appear closely linked (804a12–14, μᾶλλον ὀξυτέρᾳ . . . καὶ λεπτοτέρᾳ), though definitely not equated with each other (803b18–32).

It seems, after all, that the proposed interpretation of the argument of *Pr.* 11.6 contains only ingredients that are attested exactly in the intellectual milieu in which Peripatetic writings were originally conceived, and which would also have been available to any later redactor standing in the same tradition. Even so, and even if this interpretation is accepted, I think it would go much too far to attribute to its author the clear conception that any kind of sound potentially comprises variously pitched components. Assuming that

components.” Cf. also Barker (2002, 24 n. 4). The following discussion is greatly indebted to Barker’s exposition.

37 Mentioned in Theophrastus, fr. 716.91–98 FSH&G.

38 Cf. 801b15–21, where a similar mechanism is proposed for the effects of instruments playing together (συγχεῖσθαι τὰς φωνὰς ὑπὸ τῶν ἐτέρων), of notes sounding in consonance (ἀμφοτέρους ἀποκρύπτεσθαι τοὺς ἤχους ὑπὸ ἀλλήλων), and of musical instruments with some kind of resonator attached (τὰ χαλκεία καὶ κέρατα συνηχοῦντα ποιεῖ τοὺς ἀπὸ τῶν ὀργάνων φθόγγους <ἀ>σαφεστέρους); note that different instruments are ascribed complete φωναί, while the blended sound of consonances (imagined as played on a single instrument) consists of ἤχοι, as do individual notes blurred by resonators: συν-ηχο-ῦντα. For συμφωνία composed of ἤχοι, cf. also 803b32–804a8.

something of this sort lingered in the back of his mind is perhaps the only way to make some sense—and not the worst—of the text. However, even if the nature of the Problem may have guided our writer towards an unusually felicitous synthesis of pre-fabricated concepts and argumentative strategies, creating an original and perhaps even accurate explanation of a presumed phenomenon, the lack of emphasis exactly on the most original points conveys the impression that whoever conceived this synthesis was anything but aware of its potential.

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Understanding Odours in *Problemata* 12–13: Peripatetic Problems Concerning the Elusive Sense of Smell

Han Baltussen

How many questions does it take to understand the sense of smell? Books 12–13, dedicated to odours in the pseudo-Aristotelian *Problemata*, entitled ὅσα περὶ τὰ εὐώδη and ὅσα περὶ τὰ δυσώδη, seem to suggest at least twenty-five. But such an assessment would be overstating the intent and outcomes of these short sets of “Q&A” dramatically. As we will see, one hardly gains a comprehensive and thorough understanding of smell and odours from these books. Much is assumed or not articulated, even more not covered. The questions asked in the *Problemata* refract a scattered set of issues, which to us seem of variable quality and relevance: why ask about the effect of the rainbow on fragrance in trees? Should one ask why fragrant plants are diuretic? The apparent randomness of choice and sequence of the questions will baffle a first-time reader, while further analysis will not dispel all mysteries. For a proper understanding of the work it is important that we do not consider these books (or the work) an Aristotelian treatise in the normal sense of the word: it clearly does not have a sustained argument, is far from comprehensive, and even lacks clear statement of aim or purpose.¹

That is not to say that the work does not have an underlying coherence in philosophical outlook or a broadly thematic organisation. In outline the 38 books present a thematic arrangement that is Aristotelian. It is *within* the books that structure and coherence are far from flawless. The primary aim of this paper is to examine the content and structure of the two books, in particular the theoretical positions on the sense of smell and odours in *Pr.* 12–13 in order to assess their relationship to early Peripatetic doctrine. One reason to compare them to the first scholars (Aristotle, Theophrastus, and Strato) is that the overall work is generally considered to derive its content from their works. Although the exact purpose of the work (assuming it has one, and only

¹ Well outlined in Mayhew (2011, xxiii): the issues concern “authorship and date, purpose, organisation, sources and influences, connections” which the present volume is beginning to answer.

one) is still not fully grasped, the *problemata* can be safely regarded as exercises of some kind developed in a teaching context of the Lyceum.² Another reason is that we have some excellent comparative material in the form of Aristotle's fundamental discussion of the sense of smell in *De sensu* 5 and the analysis of its features in Theophrastus' *On Odours* (*De odoribus*) as well as his plant studies.³ This does not mean that I will as a matter of course assume that the *Problemata* always constitute a response to Aristotle or Theophrastus, or are based on these; in other words, we should not off-hand consider the latter as "sources" for the problems.⁴ It is true that *Pr.* 12–13 conform to various doctrinal positions in the works from the early Peripatetics.⁵ Yet while the underlying assumptions in *Pr.* 12–13 can often be paralleled with claims found in Aristotle and Theophrastus, there are also discrepancies. Some issues remain in certain questions and answers and the perspective implied, so we will do well not to prejudge the matter before a thorough examination of the two books.

The question of how to approach the original motivation of the work as one driven by views expressed in Aristotle's (and Theophrastus') writings will assist in considering the question whether their works were "sources" for the *Problemata*.⁶ That the first Loeb translator Hett should characterize some of the questions and answers dismissively as "childish and inconsequential" betrays his own prejudice about what the works of the Peripatos can or

2 Flashar (1962, 551 ff.) and n. 6 below. Cf. DL 5.47–48 which lists three titles of books on *problemata* for Theophrastus, a clear sign that the practice continued. See also chs. 1 and 2 in the present volume.

3 The *Investigation into Plants* (*Historia Plantarum* = HP) and *Explanations of Plants* (*Causis plantarum* = CP) include many comments on odorous qualities. For Aristotle I use Flashar (1962); for Theophrastus, *De odoribus* Hort (1926) and Eigler and Wöhrle (1993), and for the *Problemata* Hett (1970) and Mayhew (2011). For Strato I use the new edition by Sharples (2011).

4 This is what Mayhew (2011) seems to be doing in the notes of his edition and translation, perhaps following Flashar (1962), e.g. 552 "die gemeinsame Quelle für alle vier Probleme ist Theophr., De caus. plant. VI 17,1 und Od. 13." and *passim*. I would prefer to regard them as comparable materials, since the provenance of these ideas cannot be established with certainty and thus comments remain speculative.

5 The "empirical and materialistic approach" has even been connected to Strato, the successor to Theophrastus (Sharples 1993, 28 agreeing, with reservations, with Marengi 1991, who follows Gercke and Flashar). This also affects the post-Theophrastean dating of the work; see Flashar (1962, 356).

6 Mayhew (2011, xxi–xxii); Flashar (1962, 344): "Alle diese Besonderheiten [i.e. several answers, repetitions, corrections etc.] lassen sich am zwanglosesten durch die Annahme erklären, daß die Form der Probl. aus der lebendigen Schuldiskussion stammt."

should be like.⁷ If, however, we allow for a more generous stance, which does not misjudge or over-interpret their peculiar nature, we can go along with the position that they seem to have originated in the oral environment of the Lyceum, recording over time the questions about generally held views—even folklore beliefs—which could trigger further discussion.⁸ As Sharples put it, “what motivates the discussion is intellectual curiosity”.⁹ The nature of many questions—random, naïve or even silly to us—at best suggests an exploration of any *possible* question with regard to a topic, and at worst, a badly arranged and poorly understood version of Peripatetic doctrine for which we happen to have the “correct” version. Neither of these interpretations is really satisfactory. The least we can say is that they are most likely a record of uncensored asking (and answering) of questions, which belong to a pre-scientific age where the pedagogical purpose may have been to train students’ minds in considering every aspect of a problem under scrutiny. Such a perspective would fit the dialectical tradition of working through *paradoxa* and *aporiai*, puzzling facts and statements which raise questions, because they may go against our expectation or intuitions about the state of the world.¹⁰ That the *problêma* format was not just an exercise, but a practical training, a preparation for the study of existing ideas and *theories* is clear from the list of Aristotle’s works, in which at DL 5.26 we find the title προβλήματα ἐκ τοῦ Δημοκρίτου β’ (“Problems from the work of Democritus, 2 books”). This suggests that *problêma* questions could also be extracted from the philosophy of a predecessor.¹¹ Clearly his work led to extensive questioning of a theory (*two* books), which from a Peripatetic perspective was intrinsically problematic (no pun intended). But the discrepancies between Aristotelian allusions to a work of *Problêmata* and the preserved work also indicate that the one Aristotle has in mind is not the one we are

7 Hett (1970, xii).

8 Mayhew (2011, xvi) also makes the point about accumulation over time, but does not comment on συναγωγή. My concern is to explain its use, esp. in the genitive form.

9 Sharples (2006, 22).

10 Cf. Flashar (1962, 343): “damit ist zugleich die Aufgabe gestellt, das scheinbar Paradoxe und Sinnwidrige als sinnvoll zu erweisen”.

11 DL 5.26 (best new edition for DL is Dorandi (2013)). Flashar (1962, 302) notes that the first reference to *problemata* is connected to Democritus, works with titles beginning with αἰτίαι (see 68B1b–11k DK). On Democritus and the *Problemata*, see ch. 2 in the present collection.

examining here.¹² But we should not forget that Theophrastus' list of works also presents a προβλημάτων συναγωγής.¹³

I would like to make one further observation about the nature of the collection. The fact that the manuscripts (e.g. *Paris. gr.* 2036, 1r) transmit the keyword of the title 'Αριστοτέλους φυσικά προβλήματα κατ' εἶδος συναγωγῆς ("physical problems of a *collection* by kind") may suggest an organizational activity of a date later than its composition, since in a philosophical context συναγωγή is almost without fail used for a retrospective collection of arguments or views without much creative input.¹⁴ The difference between two other arrangements of *problemata* is also striking (Mayhew 2011, xix): DL 5.26 [no. 121] seems to refer to "physical problems arranged by element" (Φυσικῶν προβλημάτων κατὰ στοιχείον), i.e. alphabetically, and Arist. *Mete.* 363a21–25 has κατὰ μέρος "by specific part/feature" (as opposed to general/generic feature, κατὰ γένος).¹⁵ One can hardly avoid the conclusion that these are two different works, arranged according to two very different principles.¹⁶

1 Topic and Argumentative Style in *Pr.* 12 and 13¹⁷

Pr. 12 and 13 come after the book on the voice (11) and before the book on mixtures (14).¹⁸ They offer a small set of puzzles on quite specific aspects of "good"

12 Flashar (1962, 304–305) discusses some secure references to the real work ("Die sichersten Zeugnisse der echten Probl."). A close correspondence like the one between 958b14, 959a15, and Arist. *Metaph.* Δ.6.1011a32–34 must then be explained by assuming an overlap between the two works on *Problēmata*.

13 DL 5.45: *Collection of Problems* in five books (α' β' γ' δ' ε').

14 E.g., Athen. *Deipn.* 13.6.3 (Hippias), DL 5.24 Τεχνῶν συναγωγῇ α' β' (Aristotle), 5.25 Συναγωγῆς α' β'; 5.43 Τῶν Διογένους συναγωγῇ α', 5.47 Λόγων συναγωγῇ α' (Theophrastus). Cf. Mansfeld & Runia (1997), 132. Flashar calls this type of collection "unproductive[r] Art von Sammeln" (1962: 357).

15 Note that Mayhew (2011, xix) translates "alphabetically" and "according to part" respectively. Flashar (1962, 310–11) points out that κατὰ στοιχείον may mean (1) a systematic arrangement, as Usener has argued for Theophrastus' work on laws (which he rejects), or (2) "according to the letters of the alphabet" *as letters, not numbers* ("als Buchstaben, nicht als Zahlen").

16 Similar conclusion in Flashar (1962, 310–15).

17 This section summarises only the main features for *Pr.* 12–13. For a lengthy discussion of the whole work, see Flashar (1962, 297 ff.), esp. on form (341–46), language (347–56).

18 This sequence is partially Aristotelian (see below n.24), although books 31–33 (eyes, ears, nose) conform more closely to the one in *DA* 2.6–10 and *Sens.* 3–6.

(ἐὺ-) and “bad” (δυσ-) smells.¹⁹ I use the word “puzzles” advisedly here, because strictly speaking Peripatetic προβλήματα are questions of a very specific kind: each question as a rule opens with διὰ τί (“why?”) and next offers bifurcated (or sometimes even trifurcated) answers in which different possible explanations are explored, as a rule with the disjunctive pair πότερον . . . ἢ (. . . ἢ);²⁰ the second (or last) option often seems to be preferred, but there is no clear indication of the level of commitment to the answer. In books 12–13 this pattern still holds in broad terms, although on occasion the preference is not so clear, mainly because only one option is offered (see below).

As a technical term, πρόβλημα is used in Aristotle’s dialectical treatise, *Topics*, in which it is at the core of what the work is recording and analysing.²¹ It is significant that among the crucial questions which Aristotle defined for scientific research in *APo.* 2.1, the διὰ τί question is the second (asking about the cause i.e. “why?”, “for what reason?”) after the question of fact (whether something is the case or not) and before the question of existence, and the question of essence.²² He declares the answer to each question to belong to four kinds of knowledge. In the *Problemata* we will find that the existence of a thing is often simply assumed, while the focus is on the “why.”

It will be useful to give some historical context by setting out a few points on the existing explanations for the sense of smell. In the archaic period these were tentative at best, and speculative or fantastical at worst.²³ Like today, smells were probably amongst the most mysterious of sensory phenomena. Knowledge about them drew on everyday life experience and perception, but, because smells are present yet invisible, explaining and understanding what could not be seen proved a real challenge. As time progressed, explanatory proposals became more daring, but never empirically tested.

19 Other places where smell and odours are briefly discussed are 2.13 (unguents and the smell of sweat), 7.6 (smell in irrational animals), 10.18 & 54 (sneezing), 28.7 (taste/touch and self-control), 33.10 & 15 (sneezing).

20 Flashar (1962, 299).

21 Dialectical reasoning was primarily about *problēmata* (*Top.* 1.4.101b16f.; cf. *SE* 183a38 περὶ τοῦ προβλήματος). See Baltussen (2000, 34–35). For its formal aspect see Flashar (1962, 341–46, esp. 343). I accept Mayhew’s suggestion (2011, xxi) that the various cross-references in the Aristotelian corpus can be explained by assuming that the work started as Aristotle’s (see above text to n. 6) and was subsequently expanded by his followers.

22 Mayhew (2011, xxii) raises this point but does not make a connection with the types of question in *APo.* See on this esp. Mansfeld (1990, 3205–208) for its relevance to collections of *doxai* and problems in the Peripatetic and doxographical traditions.

23 In my general characterisation of the topic I make use of my Baltussen (forthcoming 2014).

In Homeric times only two types of odour were distinguished (pleasant, *äutmê*, and unpleasant, *odmê*; e.g. *Od.* 12.369; 17.270), an indication that the understanding of the nature of smell was rather vague. The so-called Presocratics, better described as natural philosophers (*phusikoi*), went beyond this binary assessment, but their explanations remained highly speculative.²⁴ Much of the surviving evidence needs to be considered carefully, since its nature and objectives are not uniform. Here we have to avoid anachronistic assumptions about what the *auteurs* of the problems were doing: their questioning is far removed from the “scientific papers” which Aristotle and Theophrastus produced in natural and cognitive science. Plato’s attempt at explaining the sense of smell was novel in some ways, but criticised by Aristotle and Theophrastus.²⁵ One cannot deny that Aristotle was the first to offer a truly empirical and systematic study and explanation of the senses. But then, Plato’s primary interest was not in physics, but in acquiring knowledge of the metaphysical foundations that informed it.

The Aristotelian explanation of smell relies on two basic notions, which he developed in the context of his physics and ethics: the notion of compatibility and the dual notions of potentiality and actuality.²⁶ The first idea works on the assumption that sense perception occurs between an organ and sense objects because they are naturally attuned to each other (a sign of Aristotle’s epistemological optimism), but that for the process of sensation to take place—i.e. recognition of the object by the appropriate organ—an adjustment of the one to the other may be necessary; this is often described in terms of potentiality.

This is the second aspect (the notions of potentiality and actuality), which constitutes an attempt to bridge the cognitive “gap” between organ and sense object. His crucial position in his account of smell on how we perceive odours is stated at *De sensu* 5, where Aristotle defines smell according to the two properties which also occur in earlier theories; pleasant (e.g. flowers) and

24 Our main source is Theophrastus’ *De sensu* (Diels *Doxographi* 1879: 499–527; Stratton 1917).

25 Plato offers an account in the tradition of natural philosophy at *Tim.* 66d–67a. His theory was labelled “unconvincing” by Cornford in his commentary on the *Timaeus* (1956, 274). Aristotle’s critique is found in *DA* 420a29–30, 421a26–27; 422b10 ff.; *Sens.* 437b11, 15; 443b17–18; Theophrastus presents his critical evaluation of Plato’s views in several places, esp. *Sens.* 89–90 and *CP* 6.1.4–5.

26 In what follows I am guided by the excellent analysis in Johansen (1996). It is important to note that our sources for theories of Presocratics are mostly Peripatetic, which is clear especially in the way in which they have been coloured by the model that assumes a Peripatetic hierarchy of senses: 1. vision, 2. hearing, 3. smell, 4. taste, 5. touch. See e.g. Theophrastus *Sens.* 4, 7, 9, 25.

unpleasant (e.g. fumes of charcoal 444b30–445a1).²⁷ Basically smell is caused by the dry part of taste. Because perception is a process of change (hence part of physics) whereby “an agent acts on a patient”²⁸ the ensuing interaction leads to assimilation of agent and patient (*DA* 2.5.418a3 ff.): here the potentiality of the agent to become like the patient (and vice versa) depends on the nature of each. Aristotle explained the transmission of the olfactory information from the point of origin to the sense organ as follows. He suggested that odours move from, say, a flower to the nose by way of a medium, air. Thus he tried to guarantee the delivery of reliable information: the notion of continuous contact seems to underlie this mechanism, because otherwise he could not imagine how the information could cross a certain distance. The medium also accounts for distortion, since it operates as a kind of filter (“the moist, whether in air or in water, should imbibe the influence of, and have effects wrought in it by, the sapid dryness,” *Sens.* 443b4–9; for colours and a medium, cf. Strato fr. 64 Sharples). It is important to note that Aristotle rejected the emanation theory of smell (*Sens.* 5), which makes its appearance in Theophrastus *De sensu* 9 unusual.²⁹

2 Olfactory *Problēmata* and Aristotelian Dogma

That the two books under review here divide the question into pleasant (*Pr.* 12) and unpleasant odours (*Pr.* 13) suggests that, like today, the sense of smell operates along a very rough scale between the extremes of repulsion and attraction. These are vague notions which are culturally determined: one outcome of our investigation will be that in the *Problemata* we will learn something about the olfactory sensitivities of classical Greece.

The introductory comments on books 12–13 have probably confirmed the impression that these books give a random series of questions.³⁰ But such an approach may well betray a false expectation: how much organisation can we expect from a collection (συναγωγή) of this kind? At least all sections relate thematically to odours and the mechanism of smell. One must dig a little

27 As Johansen (1996, 6) points out, this is not quite what one expects after reading *DA* 2.9.

28 Johansen (1996, 2).

29 It seems to have the support of Theophrastus. Cf. Mayhew (2011, 405); Sharples (1993, 29). Sharples also points to the problematic passage in *Sens.* 9 on Empedocles which has been explained by Sedley (1985) as having a different focus. See also Sharples (1985).

30 Already Flashar notes there is no obvious structure or sequence, “kein klar gegliederter Aufbau” (1962, 551).

deeper to uncover the Aristotelian assumptions underlying the argumentative explorations and moves, and to find signs of organisational intent and doctrinal allegiances.

On closer inspection, the two books on odours exhibit a comfortable closeness to several Aristotelian doctrines, but, as Mayhew has pointed out, the best textual parallels tend to come from the works of Theophrastus (*Od.*, *CP*, *Sens.*). In this section I will point to some doctrinal links between the *Problemata* and Peripatetic doctrine on smell and odours, while commenting on structure and themes in *Pr.* 12–13. One significant deviation from Aristotle's view is that *Pr.* 12–13 and Theophrastus seem to support an emanation theory of odour, in which particles emanate from objects, slowly depleting their bulk.³¹

In Book 12 the sequence of points raised roughly goes from the relation of odours to distance, cold, the rainbow, spices and roses; to the question whether odour is vapour or smoke; to fragrance and diuretic effects; and the difference in fragrance between mixed and unmixed wine.³² The division into “pleasant” (here τὰ εὐώδη) and “unpleasant” (τὰ δυσώδη) is, as we already saw, quite traditional.³³ This perspective continued to guide philosophical analysis from Homer down to at least Plato (*Tim.* 67a, “the only clear distinction to be drawn is twofold: the pleasant and the unpleasant”). Aristotle also uses it as a rough outline, but as explained in the previous section, his analysis adopts further criteria which offer several refinements to the existing models.³⁴

Several general principles of explanation inform the questions and suggested answers, but they remain unarticulated. Many of the ideas employ a mechanical and materialistic explanation of smell: thus *Pr.* 13.2 connects intensity of smell to “bits of earth” coming away with smell, causing a less pleasant smell closer to the source. This idea suggests that an earthy emanation is the cause of bad odour and that the intensity of an odour is inversely proportionate to the distance between observer and the source of odour. Aristotle mentions something similar at *DA* 421b9–12, but Theophrastus offers the more secure parallel for this idea (*CP* 6.17 and *Od.* 12–13).

31 Cf. Mayhew (2011, 405); cf. Sharples (1993, 29).

32 I paraphrase Mayhew (2011, 405).

33 Already found in Homer (*äutmé* vs. *odmé*). Examples at *Od.* 12.369; 17.270. Note, however, that *odmé* is occasionally also used for “pleasant,” e.g. *Od.* 5.59 and 9.210, so that *äutmé* and *odmé* are not always opposites. See also Körner (1932).

34 His use of a “golden mean” between extremes (originally in ethics, where virtues are ideally between the extremes of excess and deficiency) is meant to describe the ideal case, but it does not work well because the extremes are not as clear as in other senses.

Pr. 12.3 (on the effect of the rainbow on the scent of trees³⁵ on which see below) connects sweet scent with moistness, while water is declared crucial for smell to occur at all (906b25); it also talks about concoction (πέψις), which in the biological works of Aristotle and botanical works of Theophrastus refers to the process in which innate heat “concocts” or thickens fluids, leading to the softening or ripening of fruits, or to dried-up residues.³⁶ *Pr.* 12.5 connects smell with things being in motion (cf. 13.12), and 12.6 to cold and the diminution of smells in winter, which is then also linked to motion (cold leads to less motion). Incidentally, 12.11 might just as well have been in book 13: it asks “why do spices have a more acrid odour when they are burned on ashes than on fire?” Thus we see how the main doctrinal components in book 12 assume some basic elements of physical and physiological theory in the Peripatos.

Pr. 12.12 discusses one medical topic which seems to have been a common talking point among educated men: the diuretic qualities of certain substances.³⁷ In the *Table Talks* (*Deipnosophists*) of the polymath and bibliophile Athenaeus, the point comes up when discussing wine (1.32C “white wine most refined in nature, [is] diuretic” etc.). In 9.371A–B he contrasts white with black cabbage (?), calling the latter “more diuretic”. This is one of a number of medical topics, and the topic of 12.12 is also discussed in *Hp. Acut.* 53 (cf. *Pr.* 865a19) and frequently in Galen’s works, who points out that all physicians use diuretics (*De atra bile* 5.129.13 Kühn), while mentioning among diuretic substances celery, honey, and wines (*De san. tuend.* 6.353.9 Kühn).³⁸ We have here a case in which the existence of such plants and seeds, or, more to the point, diuretic agents, is not questioned, but simply assumed (see above, p. 172).

There are a number of motifs that appear in several of the questions. Unsurprisingly, the burning of incense comes up several times (12.1, 2, 4, 9, 11), as do flowers, in particular roses (12.2, 3, 4, 9). Given that many of the problems arise from simple observations, they will be on things most associated with situations and events where odours are particularly significant, probably in the context of rituals, food preparation and whatever else involves burning and cooking things.

35 A hearsay claim (<διὰ τί> λέγεται 906a36), possibly originating with the shepherds mentioned at b5, as is suggested by Mayhew 2012, 252.

36 Arist. *Mete.* 379b18; the cooking of food, *ibid.* 380b13. Thphr. *CP* 6.6.1. See Steinmetz (1964, 26, 27, 36 etc.).

37 On medical content of the *Problemata* see Flashar (1962, 299 & 316) and Kapetanaki-Sharpley (2006).

38 A TLG search for *ourêtik-* produces 504 hits (much more if we include *diourêtik-*).

Thematically, *Pr.* 13 contains several problems which make use of a link between bad odour and motion (see my section 3 below), and between odour and heat. There is a comparison between urine and faeces (why they do not become equally malodorous when staying in the body longer, 13.1), a surprising claim that flowers when rubbed become malodorous (13.3),³⁹ and the more general assertion that no animals are fragrant (humans excluded, it seems), except the panther (13.4; this is a rather long section which refers to both good and bad odours and contains a short exposition on passing gas and belching). The question on cold reducing bad odour (13.5) is the opposite to 12.6. Such is the extent of thematic connections and threads as they emerge from the various problems.

3 Three Case Studies: Key Concepts in the Mechanism of Smell

Even though books 12 and 13 are relatively short, it would take too long within the present scope to discuss in detail all individual *problēmata* and their link to Peripatetic doctrine. I therefore will treat three cases in greater detail in order to illustrate their (a) argumentative form, (b) their Peripatetic allegiance, and (c) their scope.

Case 1: Distance and Intensity (Pr. 12.1)

One of the more frequent motifs in *Pr.* 12–13 is the relationship between distance and intensity of odour: it is used in the “opening gambit” at 12.1 and recurs again in combination with other aspects at 12.2, 12.4 (in content close to 12.1), 12.9.⁴⁰ The view that an odour is more powerful at a distance was already supported by the Presocratic Anaxagoras, who is reported by Theophrastus to have made the (contradictory) claims that “(i) rarefied air has a stronger odour, since it is odorous when heated and rendered less dense . . . For (ii) an odour nearby is more intense than one remote, he holds, because it is denser and in

39 Where the earthy part is again associated with bad odour, see also *Pr.* 12.9, 12.11, 13.11.

40 At *Pr.* 12.10 Mayhew (2011, 415n) adduces Theophrastus *Sens.* 85 and 90 in a footnote, but the reference to §85 is misleading: here Theophrastus is paraphrasing Plato's views, so it can hardly be taken as a Peripatetic parallel (which must be the force of Mayhew's “Cf.”). As to §90, there Theophrastus criticizes Plato, and validates his point by way of an *endoxon* (a view held by the majority, the many or the experts, cf. *Top.* 1.1.100b21–23) without specifying whether Peripatetics are meant. However, if the parallels are merely intended to suggest that Th. had some knowledge of the (archaic) notion of air as vapour, the “parallels” may stand. In my view *CP* 6.17.1 (which Mayhew notes *ad loc.*) is preferable as a parallel.

scattering becomes faint" (*Sens.* 30).⁴¹ The Peripatetic Hieronymus of Rhodes also held that distance and fineness correlate to a better smell from flowers, and the cause given for *diminished* fragrance is that "earthy and muddy particles are emitted with the scent and these ruin its fragrance when it is received from nearby".⁴² Yet 13.4 implies that moisture plays an important role, since there the point is that concoction gets rid of moisture (and "unconcocted residue", περίττωμα ἄπεπτον, 908a7), which would cause bad odour. The evidence proffered in support of this concerns bones and hair (no moisture, no bad odour).⁴³

At *Pr.* 12.1 a straightforward question is asked about why people perceive burning incense less when they are near it, implying that this is the opposite of what one might expect.⁴⁴ Here "less" adds another important component to the analytical mix, since the "more and less," that is, issues of degree, are a familiar point of interest in the Peripatetic works. Aristotle uses this pair as tools for establishing not only the degree to which a quality holds, but also for truth values in reasoning or how much knowledge we have of a thing.⁴⁵ Concerning smells, he uses it in connection with the difficulty of defining them (ἥττον εὐδιόριστον, "less easy to define", *DA* 421a7). One might of course argue that this way of speaking may be expected from someone who is keen on making subtle distinctions, but this is not a mere lexical mannerism: both Aristotle and Theophrastus have well-considered views on the terms and use them deliberately and purposefully (see n. 34). The terms are therefore clear markers for Peripatetic scientific writing. *Pr.* 12.1 proceeds by suggesting that the odour of incense may become mixed with (and hence diluted by) air while travelling. The terminology is not typically Aristotelian here, since ἀπόρροια ("effluences") is associated with theories of perception that use the extramission principle, whereby particles flow from objects in order for these to become perceptible. The word only occurs fourteen times in the whole corpus, including the *Problemata*, which has three cases (906a4, 929b29, 967b22). It only occurs twice in Theophrastus, both in *De sensu* and neither case represents

41 Theophrastus does not object to this, except that he does not agree with the related assumption that size of particles is crucial in perception (*Sens.* 37).

42 Noted by Mayhew *ad loc.* The text is fr. 10 White = Plut. *Quaest. conviv.* 1.8.626A–B = fr. 53 Wehrli. White (2004) also points to useful parallels in *Pr.* 31.

43 Perhaps material also came from Theophrastus' περί τριχῶν α', *On Hairs* (DL 5.45).

44 Note how it is taken as read that incense belongs to the pleasant smells, a verdict which may well differ from the modern sensibility.

45 E.g. *APr.* 66a8, *APo.* 85b6; cf. *Cat.* 3b33–34, 4a8–9, 6a19–20. Out of the 718 occurrences of ἥττον across the whole corpus (logic, metaphysics, ethics, biology, physics, meteorology, poetics, and politics), the *Problemata* contain 137 (nearly 20%). (Source: a TLG search for ἥττον in Aristotle, 17/1/14.)

his own view: first, in the description of the two main groups and principles of the mechanism of perception (*De sensu* 1, where it is closely associated with Plato and Empedocles) and second, in *De sensu* 74, when Theophrastus is criticising Democritus' theory of colour. Notably, only one of all these contexts is related to the sense of smell and odours: Arist. *Sens.* 443b1–5 discursively analyses odours and rejects the notion that “exhalation” or “effluence” (ἀναθυμίασις, the favoured term in Aristotle and Theophrastus) is the same as “emanations” (ἀπόρροις), as some claim” (λέγεται).⁴⁶ The whole discussion operates within a sphere of common opinions and generally held beliefs, where the Peripatetic content seems de-emphasised. For possible parallels (or comparable materials, as I prefer to call them⁴⁷) we may point to Theophrastus' use of δοξειεν in *HP* 1.7.2, *CP* 2.11.8, 5.3.4; *Sens.* 34; *Lap.* 10, 54; *Sud.* 7.1 and δοκεῖ, *CP* 4.12.1, *Sens.* 31, 34, 87, 88.

In terms of argument, this section develops a short answer in one direction, and then explores its opposite, using the typical “either ... or ...” (πότερον ... ἢ) structure. In the first instance, the suggested reason for diminished perception nearer to incense is that it may become mixed with air, “like the myrrh of the physicians.” It is not so easy to determine what point this comparison is meant to convey, but the phrasing “being less powerful when mixed with air, is more pleasant” at least suggests that air reduces the powerful odour and thus makes the burnt offerings more pleasant, “like myrrh.”⁴⁸ It also makes myrrh by default pleasant, at least more so than burnt offerings (θυμιάματα). Physician's myrrh may refer to the type of myrrh that has special olfactory properties, as may be gleaned from Hippocratic works.⁴⁹ In addition, Theophrastus reveals that “it is held (δοκεῖ) that myrrh, when soaked in hydromel or sweet wine, burns with a more agreeable odour than when unmixed” (*CP* 6.17.2, cf. *Od.* 44, 67). Once again, an *endoxon* is used to complete an argument, confirmation that the discourse takes place within a dialectical framework, which as the *Topics* make clear, focuses on “generally held beliefs, supported by all, many or the experts” (100b21–23).

46 Aristotle and Theophrastus use ἀναθυμίασις in physics, physiology, and meteorology: e.g. *De sensu* 443a21–31 (Heraclitus); *Mete.* 340b26 (dry exhalation from the earth), but oddly, only twice in *De ventis*. See also Steinmetz (1964), 57, 69, 73–74, 209–11 and below section 3 (b).

47 See Mayhew (2011, 407n.) and n. 4 above.

48 According to LSJ myrrh (σμύρνα) is the gum of an Arabian tree; it was used to embalm the dead (Hdt. 2.40, 86), and used as unguent (Ar. *Eq.* 1332), cf. Thphr. *HP* 9.1.2, 9.4.3 and 10.

49 Hp. *Superf.* 33.8.14; *Ulc.* 12.24.26. Or it refers to the unguents physicians made, as Galen illustrates in *SMT* 9.728.9; *MM* 4.10.160.1; Diosc. *Mat. med.* 1.18 and 1.65.

The second option seems to be favoured here (its final clause starts with διὸ καὶ), namely, that the fire “removes the smell by burning the incense.” “Removes” (ἀφαίρεισθαι) is not to be understood as a permanent action, since the odour is still said to be present further away from the coals where “it appears to be purer and very light.” This last comment is of special interest, as it brings us back to Theophrastean comments in both *De sensu* and *De causis plantarum*.

As to the scope of *Pr.* 12.1, we may be brief: the section deals with a very focused point, the odour of burning incense, along a very specific line of inquiry (the role of distance). It is of some importance that, although the next section (12.2) deals roughly with the same issue, we should also note a few small but significant differences between them. In *Pr.* 12.2 incense *and flowers* are discussed; the answer considers additional factors (earthy particles, their weight, the scattering of odour); and last but not least, unlike 12.2, 12.1 seems to emphasise the subjective experience of smelling incense, given how the question is phrased in relation to the perceiver: (αἰσθάνεσθαι πλῆσιον ὄντες, “[why do] *those who are near* perceive ...”).

Case 2: Heat, Motion, and Bad Odour (Pr. 13.5–7)

The second example is about the relationship between bad odour and motion. *Pr.* 13.5, 6 and 12 (also linking speed to saturation of air) incorporate this connection (cf. 7 motion and bad breath), and adds some further ingredients to the analysis. The question raised in 13.5 is “Why are malodorous things (τὰ δυσώδη) more malodorous when hot than when they are cooled? Is it because smell is vapour and an emanation?” In what follows a simple syllogistic argument is developed in order to show that (i) vapour is due to heat, (ii) heat causes motion, therefore (iii) vapour is an emanation. The opposite, cold, causes stagnation and contraction, moving things downwards (heat moves things upwards). So far so good. But the next step does not quite have the required logical quality one might hope for, no matter how basic: “heat and all smells move upwards because they are in air, and their organ is above and not below.” This is odd: the *location* of the organ can hardly be the *cause* for odours to move upwards (a very forced attempt at teleology). The final step is a kind of add-on comment, which, even if true, looks like a *non-sequitur*: “for (γὰρ) by reaching the brain the odour produces a sensation.” This claim may well be related to smell in general, but how does it fit here? It would seem that the last few steps focus on the upward motion, and that reaching the brain is seen as the end point of that trajectory. It is, however, unexpected to see the brain mentioned in this context, since according to Aristotle it is not the brain that is the central sensory organ, but rather the (substance around the) heart (e.g. *DA* 408b5–10, 433b29–31; *Juv.* 479b17–480a15; *PA* 656a27–28). Brain and heart

are opposites because the former cools, whereas the latter produces heat. A role for the brain in sense perception was first claimed by Alcmaëon (c. 500 BCE) and Anaxagoras and Diogenes of Apollonia, as Theophrastus reports in *Sens.* 25, 38, and 39.⁵⁰ Aristotle only admits to a process whereby the odour reaches an area *near* the brain (438b25–26), while he denies the brain any sensory function at *PA* 656a19–24⁵¹ and *Somn.* 457b26–458a9. In short, the view referenced here does not quite fit the Peripatetic stance, unless we assume it is linked to Strato's view, which gave the area near the brain a more prominent role, placing the soul in the space “between the eye brows” (fr. 57 Sharples) and considering the brain the “ruling part” or central organ for sensory perception (fr. 63B Sharples).⁵²

Case 3: Garlic, Urine, and Other Bad Odours (Pr. 13.6)

Pr. 13.6 is not only the second-longest of problems in this book (after 13.4), but also different in other respects. It considers the question of why urine has a bad odour when one has eaten garlic; an observation clearly from everyday life.⁵³ But the question is not just about this kind of bad odour (garlicky urine): the puzzle raised is why other things which have a strong smell before being digested do not cause malodorous urine. The underlying perspective seems to be to look for broader consistency: a general rule one might assume off hand is “bad smell in, bad smell out”; but garlic seems the only substance that fits this hypothesis.

The answer considered is said to be a claim “much like some of those who uphold Heraclitean views say” (ὥσπερ τινὲς τῶν ἡρακλιτιζόντων).⁵⁴ The link with the Heraclitean view must lie in the notion of vapour or exhalation. Both Aristotle and Theophrastus would use ἀναθυμίασις when mentioning

50 Noted in Flashar (1962, 557n. 5) ad loc. See also Baltussen (2000, 21).

51 Flashar (1962, 557n. 5) ad loc. refers to 656a14 ff., but I here give the precise reference.

52 Flashar ad loc. refers to fr. 110–11 Wehrli = fr. 63AB Sharples.

53 And medicine: Flashar claims [Hippocrates] *Morb.* 4.56 as the source (“Quelle”).

54 Mayhew points to fr. 22A15 and B12 DK. Unlike Mayhew and LSJ, I prefer a weaker translation for ἡρακλιτίζω as “uphold Heraclitean views” to “Heracliteans” or “followers of Heraclitus,” because the one does not entail the other. (*Followers* of Heraclitus is almost a contradiction in terms, given his misanthropic tendencies and secluded lifestyle.) LSJ’s translation for Aristotle *Metaph.* 1010a11 where it links Cratylus’ view to ἡ (sc. δόξα) τῶν φασκόντων ἡρακλιτίζειν, “be a follower of Heraclitus” seems insensitive to the context. Surely Aristotle is joking, creating a verb of Heraclitus’ name (a unique case) to ridicule the view at issue, and the qualifying force of φάσκω should be heeded: it suggests we need not believe them or take them seriously. In our passage, the reference is rather vague to those who “talk like” Heraclitus.

Heraclitus' claim that the soul is vapour.⁵⁵ Aristotle and Theophrastus applied the term to the meteorological process of evaporation and condensation; the Heracliteanising thinkers alluded to here assume an analogy with a moist exhalation in the body ("vaporising takes place in the body just as it does in the universe," Mayhew trans.). But the author goes on to argue that it also involves condensation after cooling down, inferring that the smell is produced by the end-product of this process, a mixture, "for smell occurs when there is a change (μεταβάλλῃ)" (908a34). Here we are in Aristotelian territory: perception as change (κίνησις, ἀλλοιώσις) is a quite standard position.⁵⁶ Again, a follow-up question shows how the perspective originates in a quest for broader consistency: "shouldn't *all* the other things that have a strong smell also produce this result?" The examples for such an assumption back this up: wine or radish have different effects in the body, but at least have one of two results, bad odour or wind ("internal breath"). Garlic, it is claimed, has both effects, leading to its residue reaching the bladder and making urine smell. One is hardly persuaded, but still somehow impressed by the effort to reach a sensible and logical explanation.

These three case studies illustrate the argumentative approach and doctrinal assumptions of the problems in general, but much is still inconclusive and unresolved. It is clear that Peripatetic theory is presupposed, but it remains implicit and poorly utilised. Yet there are exceptions (e.g. the claim that smell occurs when it penetrates to the brain 13.5).

4 Conclusion

I have given a very selective analysis of the two books on odours, since it is impossible to give a brief and coherent interpretation of such an inchoate body of material. What, then, do *Pr.* 12–13 teach us about smell and odours? Very little, it would seem. Answering twenty five questions—often tentatively—does not a theory make. Nor is there a general statement of Peripatetic understanding of the mechanism of smell, nor any detail on the basic workings, even if many factors playing a role in the mechanism get some airing (such as heat and cold, motion, distance, and concoction). The value judgement attached to the sense of smell, as Aristotle saw it, is not even hinted at: smell comes third in line among the senses, *because it is the worst in humans* (*DA* 2.9.421a7–11; Thphr. *CP* 6.5.3). Its importance relative to sight and hearing can be illustrated

55 Aristotle *DA* 405a24—as do Aetius *Plac.* 4.3.12 and Arius Didymus (in Eusebius *PE* 15.20 where the soul is said to be a "perceptive exhalation" according to Zeno and Heraclitus).

56 Arist. *Sens.* 446b28, *GC* 1.1., Thphr. *Sens.* 2, 14, 23, 26 etc., *CP* 6.6.4 (on flavours).

by the endorsement of the generally accepted view that sight is the superior sense (Arist. *Metaph.* 1.1), the judgment implicit in the order in which they are discussed (Arist. *DA* 2.7–9, *Sens.* 2–5; Thphr. *Sens.* 5–6, 9, etc.), and because of the fact that there is only one separate work on odours (Thphr. *Od.*, though *CP* 6 is an elaborate discussion of odours related to plants; cf. *DL* 5.45), but several individual books on, or related to, vision (two on sight: *περί ὀψεως* by Theophrastus *DL* 5.49 and Strato *DL* 5.59, and one on colours by Theophrastus, *DL* 5.43. *περί χυμῶν, χροῶν, σαρκῶν α'*).⁵⁷

If such fundamental doctrines cannot be found here, what do *Pr.* 12–13 present us with? While these books hardly constitute the last word on the sense of smell and odours, they do teach us something about modes of debate on Aristotelian foundations of knowledge. On a superficial level, certain topics could be expected in a discussion of good and bad odours. There is some allusion to unguents, ointments or perfumes in book 12, and one clear mention of sweating in 13.9. In book 13 there is limited reference to human waste (urine, faeces only in 13.1), and only one related to rotting of organic products (13.4.908a5–11), which we know were the curse of ancient cities.⁵⁸ What the problems in *Pr.* 12–13 all share is that they mostly discuss topics which belong to the urban sphere linked in particular religious ritual (burning of incense, myrrh), the household (plants and seeds, garlic, and fasting), and medical practices (unguents and human excretions of all kinds).

Philosophically, then, there is no systematic thinking, no propaedeutic outline, no clear direction to the overall body of knowledge. The questions do not even exhaust the possible number of puzzles with regard to such a mysterious sense organ. They do address some important aspects of it, but only *in so far as* (1) they are triggered by one's *immediate observation* and (2) they *contravene one's intuitive expectations*. But then we could hardly expect a lot of structure or doctrinal clarity from a conglomerate of thematically related questions which have been accumulated over more than a century. In the final analysis, one cannot but wonder who would be interested in this version of the school's doctrines: if they are presumed to be derived from the works of the early scholarchs, their representation of them is uneven, confused and unreliable. Did they make the authoritative works of the first two (or three) scholars redundant? Surely not. Or were they just exercise material? Clearly the analysis of smell and odours is too superficial and remote from the actual Peripatetic doctrine to be of real use, either as *Lehrschrift* or as dialectical exercises.

57 *περί ὀσμῶν*, *On odours* (*DL* 5.44); *περί ὀψεως*, *On sight* (5.59); on colours (5.43). Cf. *ibid.* 5.44 *περί τῶν τὰς χροῶς μεταβαλλόντων α'*. The *De coloribus* is considered Peripatetic, but probably post-Theophrastean (Gottschalk 1964).

58 See esp. Scobie (1986) and A.O. Koloski-Ostrow in Bradley (forthcoming 2014).

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The Ethnography of *Problemata* 14 in (Its Mostly Aristotelian) Context

Mariska Leunissen

1 Introduction

The title of *Problems* 14 is “as many [problems] as are about mixtures” (ὅσα περὶ κράσεις). The “mixtures” (*kraseis*) in the title refers primarily to the blends of material elements—and their properties of hot or cold, dry or wet—that characterize the environment,¹ but the term is also used to refer to the material blend that underlies the bodily features and temperaments of people in these chapters. In fact, the bulk of the problems collected in this book pertain to the *causal interaction* between the mixture of the environment and the mixture underlying the material properties of the peoples living in that environment, which result in differences of the more and the less in their character traits (chs. 1, 8, 15, and 16), their “ethnic” bodily features (4, 8, and 14), and their health, longevity, and other medical properties (3, 5–7, and 9–12).²

From the very start, the Greeks’ treatment of barbarians involved the development of ethnic “stereotypes,” whereby specific kinds of bodily features as well as particular sets of character traits are assumed to be characteristic of certain ethnic groups. These stereotypes figure prominently in the literature of this period, and also make their appearance in the many up and coming (pseudo-)sciences of that time, such as medicine and physiognomy.³ The idea that these bodily features and character traits are influenced—or even determined—by the particular material properties of the environments in which these ethnic groups live is also fairly widespread in the Classical Greek world, although some thinkers favor the influence of laws and conventions (*nomos*) over nature (*phusis*) in the shaping of human body and character. Among our

1 Hence the traditional translation of the title: “Problems concerned with Climate.”

2 The two remaining chapters deal with environmental problems that are of human interest but do not involve human properties: *Pr.* 14.2 concerns the “longevity” of grain left out in the cold in the Pontus and 14.13 discusses the phenomenon of extreme stifling heat in wintry regions.

3 See especially Hall (1997), Isaac (2004), Lape (2010) and Sassi (2001).

most prominent “scientific” sources for these ethnographical views and the debate about the role of law versus nature are the Hippocratic *Airs, Waters, Places*, Herodotus’ *Histories*, Plato (especially his *Menexenus*, *Timaeus*, and *Laws*), and Aristotle (especially his *Politics* and *Generation of Animals*).⁴ Building on these sources for comparative material, this paper will offer an analysis of the ethnographical chapters in *Pr.* 14 (i.e., 1, 4, 8, 14–16),⁵ while paying due attention to the philosophical and scientific context in which these theories were being developed. In particular, I aim to show that the kind of “environmental determinism” concerning body and character that surfaces in *Pr.* 14 is broadly Aristotelian in nature. By “broadly Aristotelian” I mean that the kinds of cultural prejudice they express as well as the kinds of causal explanations that are being offered are for the most part *more consistent* with views provided in Aristotle’s treatises than with those found in any of the other contemporary (extant) ethnographical treatises.

Before turning to these chapters, however, let me briefly present my take on the *Problems* as a whole, as these assumptions will form the backdrop for my discussion of *Pr.* 14. First, I believe that many of the problems collected in this treatise go back to Aristotle or that they are at least Aristotelian in origin, with later students of the Peripatos adding or changing or even removing some of the original problems. The way in which Aristotle refers to a treatise with the title *Problems* in his own works suggests (to me) that the problems constitute a “left-over” category of materials that deal with very specific, low-level phenomena that do not fit with the “for the most part”-type explanations that Aristotle is mostly concerned with providing in his natural treatises. Second, I believe that it is because of their specificity and low-levelness (cf. *Mete.* 2.6.363a24–25: ἐν τοῖς προβλήμασιν εἰρηθῆναι τοῖς κατὰ μέρος) of the phenomena that their explanations refer almost exclusively to material-efficient causes. The materials that are discussed in the *Problems* are thus similar in nature to those discussed in Aristotle’s *Generation of Animals* book 5: they concern phenomena—such as differences of the more and the less⁶ that occur at the sub-species level—that

4 For the most current overview of ethnographical theories in the ancient world, see Sassi (2001, 82–139). For ethnography in the Hippocratics, see Jouanna (1999, 210–32); on Herodotus, see Thomas (2000, 102–34); and on Plato, see Kamtekar (2002). I discuss Aristotle’s ethnographical views in Leunissen (2012).

5 The medical problems in *Pr.* 14 are outside of the scope of this paper, but for the combination of medical and ethnographical materials in one unit, see also the Hippocratic *Airs Waters Places*.

6 On differences of the more and the less, see *HA* 1.1.486a25–b8; *HA* 8.1.588a18–b3; *PA* 1.4.644a16–21 and b8–15; and *Metaph.* H.2.1042b29–35; Lennox (2001a, 160–81). On the type of explanations offered for these differences in *GA* 5, see Leunissen & Gotthelf (2010).

fall below the level of Aristotle's general laws of nature, and therefore (at least for the most part) do *not require* teleological explanations. (In other words, I take the rareness of teleological explanations in the *Problems* to be an indication of the kind of natural phenomena this treatise is dealing with, rather than as a sign that the collection must belong to the period after Strato). And finally, as is the case in Aristotle's *GA* 5, the *Problems* also seems to focus on issues that are particularly relevant for human practices or concerns (the number of problems that deal with human medical issues, with foods and drinks, with human virtues, and human facial features is striking to me), which might explain the continued interest in the use, preservation, and modification of this collection.

In the sections below, I discuss the following three aspects of the ethnographical materials in *Pr.* 14 and show that they are especially indebted to Aristotle's views about and explanations of ethnic differences: (1) their tripartite division of the world; (2) their use of "mixture" to refer both to the elemental blend of the environment and to that of people and their ethnic characteristics; and (3) the kinds of causal explanations offered for how these two mixtures interact.

2 A Tripartite Map of the World

The "map of the world" that can be extracted from the ethnographical chapters in *Pr.* 14 is, as I will argue, roughly Aristotelian in nature. As far as the evidence goes, the only ethnic groups that are mentioned by name in these chapters are the Ethiopians and Egyptians (in *Pr.* 14.4.909a27: οἱ Αἰθίοπες καὶ οἱ Αἰγύπτιοι) who are said to live in a hot region. The other chapters appear to divide the world into an (excessively) cold and an (excessively) hot region, with a possible third region that is characterized by "the best [environmental] mixture" (*Pr.* 14.1.909a15: ἡ . . . ἀρίστη κρᾶσις) and that is presumably found "around us" (*Pr.* 14.8.909b22: οἱ δὲ περὶ ἡμᾶς). Although there is no indication that these hot and cold regions are supposed to be continuous or that they belong to one part of the world only, I believe that the consistent association of hot regions with cowardice and wisdom and of cold regions with courage and a kind of drunkenness of mind (*Pr.* 14.8.909b9–10; 15.910a26–27; and 16.910a38–39) paints a picture that is remarkably similar to Aristotle's infamous ethnographical passage in the *Politics* that describes the personality and intellectual traits of the various people of the world (7.7.1327b18–38):

About the number of citizens, we have spoken earlier about what should be their limit; let us now speak about what should be their natural qualities. One could almost grasp this by looking at the cities that are held in

high esteem among the Greeks and, with respect to the whole inhabited world, at how it is divided into nations. Those nations that live in cold regions and the ones around Europe are full of spirit, but are lacking in intelligence and technical skill, and therefore they retain more freedom, but are without political organization and are incapable of ruling over their neighbors. The nations around Asia have intelligent and technically skillful souls, but are spiritless, and therefore retain a state of subjection and slavery. The class of the Greeks, *just as it is located in between them*, so too it participates in both [characters]. For it is both endowed with spirit and intelligent, and therefore it retains both freedom and is the best politically organized and is capable of ruling everyone, if formed into one state. The same differentiation also belongs to the Greek nations amongst each other: for some have a one-sided nature, whereas others are well-mixed with regard to both those capacities (τὰ μὲν γὰρ ἔχει τὴν φύσιν μονόκωλον, τὰ δὲ εὖ κέκρται πρὸς ἀμφοτέρας τὰς δυνάμεις ταύτας). And at this point it is clear that it is necessary for those who are likely to be the most easily led to virtue by the lawgiver to be intelligent and high-spirited in nature.⁷

The passage is rather complex, but what is important for our current purposes is that Aristotle here expresses the view—which he takes to be shared by his audience—that the world roughly consists of three climatic regions and that the people that live in each of these regions have distinct character profiles (which lead to distinct types of political organization). There is a cold region, mostly identified as Europe, where people are spirited but stupid;⁸ a region identified as Asia, where people are cowardly but intelligent, and which is presumably hot (as it is the opposite from Europe); and, finally, an intermediate region where the Greeks live and where at least some people are “well-mixed” and hence courageous and intelligent (because of this, moral development will be easier for this latter group).⁹ We also know from other texts that Aristotle locates Europe towards the north and Asia towards the south (*Mete.* 1.13.350a18–b18),¹⁰ and that he characterizes regions in Europe as not only cold

⁷ All translations are my own.

⁸ Cf. also *EN* 3.8.1115b25–30 on Aristotle’s characterization of the Celts as madmen and as fearing nothing, with *Pr.* 15.3.911a1–4 on the stupidity of the Thracians (both peoples live in the cold parts of Europe).

⁹ On this passage and its significance for Aristotle’s ethnographical views, see further Leunissen (2012).

¹⁰ However, sometimes Aristotle divides the world into Asia, Europe, and Libya (see e.g. *HA* 8.28.606b17–19: “In general, wild animals are wildest in Asia, all are the bravest in Europe,

but also moist (*GA* 5.3.782b33–783a1) and regions in Asia as not only hot but also as dry (*PA* 2.9.655a9–10). In other words, both the author of *Pr.* 14 and Aristotle associate the *same* sets of character traits with either the hotness or coldness of regions and both suggest that there is an intermediate region with a climate that is beneficial for the character of those who live there.

In addition, both authors associate very similar sets of bodily features with the hotness or coldness of the regions. For instance, both authors attribute longevity to those living in hot regions and not to those living in cold regions (cf. *Pr.* 14.15 with Arist. *Long* 1.465a7–10: “For some people are long-lived, while others are short-lived, differing from each other with regard to the regions [in which they live]: for those among the peoples who live in warm regions are longer lived, while those in cold regions are shorter lived”), explain curly hair in terms of the hotness and dryness of the region surrounding the Ethiopians (see *Pr.* 14.4 and Arist. *GA* 5.3.782b29–783a1), and place Asia—and Asiatic features such as dark eyes—towards the south, while placing Europe—and European features—towards the north (*Pr.* 14.14.910a12–13 and 23–25: πρὸς μεσημβρίαν . . . πρὸς ἄρκτον). The author of *Pr.* 14 and Aristotle express different views about the tallness of people,¹¹ but the former does single out a region “around us” where people are less extreme in size (*Pr.* 14.8.909b22–24) and thus seems to agree with Aristotle that there is third, more moderate region, which is likely where the Greeks live.

Now, this kind of division of the world into three regions which are mainly north-south oriented fits with the Hecataean map of the world (see figure 1 below), and it is also the one used by Aristotle’s teacher Plato, albeit with a slightly different use of cultural stereotypes. For in his *Republic* (435d3–436a3), Plato places the spirited Thracians and Scythians “in the region above us” (435d7: κατὰ τὸν ἄνω τόπον), associates “the love of learning” with “the region around us” (435d7: τὸν παρ’ ἡμῖν), and attributes the love of money to the Phoenicians and Egyptians, which presumably live in the southern regions below. On the other hand, this mapping of the world is distinct from the picture offered in the Hippocratic *Airs Waters Places*, which divides the world into Europe (which includes the Scythians) and Asia (which includes the Libyans and Egyptians) and which places Europe to the *west* of Asia rather than to its north (Ionia is said to take up the middle and to have the best climate, but is

and the most diverse in form in Libya”) or claims that Athens is part of Europe (*Phys.* 5.1.224b21–22).

11 *Pr.* 14.8 places tall people in both hot and cold regions, while Aristotle only places them in hot regions: see *Long* 5.466b16–22 and *HA* 8.28.605b22–24; on this distinction between the two authors, see further in section 4.2 below.



FIGURE 2 Herodotus' map

the world, slightly different from Plato's, and distinct from the maps developed in the Ionian medical and historical traditions of the time.

3 Two Types of Mixtures and their Causal Interaction

While the reference to the mixture that is of a good or ideal quality in Aristotle's *Politics* quoted above is to the mixture of the *blood* of the people who live in the intermediate region rather than to the quality of the environment itself, as is the case in *Pr.* 14.1, it is not difficult to show that both Aristotle and the author of *Pr.* 14 use the term "mixture" for the elemental mix of the environment as well as for the material nature of the people that live in that environment. In addition, both believe that these two mixtures interact causally in relevantly similar ways.

Pr. 14.1 is especially informative, because here the author makes explicit that there is a causal relation between the quality of the mixture of the environment and the quality of the mixture—possibly of body (cf. *Pr.* 3.4.871a24: ἡ κρᾶσις τοῦ σώματος), but certainly—of thought (*Pr.* 14.1.909a15–17) of the people living in that environment: “For the best mixture is beneficial (συμφέρει) also for thought, while the excessive conditions cause degenerations (αἱ δὲ ὑπερβολαὶ ἐξίστασι), and just as they distort the body, so too [do they distort] the mixture of thought (τὴν τῆς διανοίας κρᾶσιν).” In addition, he suggests that the “best mixture” of the environment is “best” because it is not excessive, and so perhaps holds some kind of mean between two extremes. Presumably, it contributes to thought by improving the material mixture that underlies the natural capacity for thinking. Extreme environmental conditions, on the other hand, corrupt the quality of the material mixture of the people that live there, and thereby distort their bodies and their capacity for thinking and render them “beastlike in characters and appearances” (*Pr.* 14.1.909a13: θηριώδεις τὰ ἔθνη καὶ τὰς ὁψεις; cf. *Pr.* 14.4, where environmental dryness is described as having a warping effect on bodies of animals, and especially on bones and hair, and *Pr.* 1.3 for similar explanations in terms of the interaction between the mixture of the environment with the material mixture that constitute health in humans).

Similarly, even though the term “mixture” is not mentioned again in the chapters that deal with ethnic traits, the author does mention “natures” that respond to extreme environmental conditions by growing hotter or cooler themselves and thereby take up a counterbalancing temperature relative to that environment (see *Pr.* 14.8.909b10–11 = *Pr.* 14.16.910a39–b1: “is it because [one’s] nature—ἡ φύσις—is in an opposite condition to the regions and seasons . . . ?” and *Pr.* 14.15.910a28–29: “for some are much hotter, on account of their nature rising up—ἐπανιούσης τῆς φύσεως αὐτῶν—due to the coldness of the region”) as well as an “internal heat” that interacts with an “external cold” and a “surrounding heat” (*Pr.* 14.14. 910a14: τοῦ ἐντὸς θερμοῦ and 910a16–19: τὸ ἐκτὸς ψυχρόν . . . τὸ περιέχον θερμόν). These references, I take it, are to Aristotelian-type *individual, material* natures that consist of a person’s blood and level of internal heat,¹⁴ which are acted upon by the material properties of the environment (on this, see further in section 4.1 below), and which can therefore be characterized as mixtures themselves. When balanced or proportionate, this kind of mixture of the body is elsewhere said to produce the health of the body

14 Pace Mayhew (2011, 443 and 449) who takes nature in *Pr.* 14.8 and 14.16 (but not in *Pr.* 14.15) to refer to the nature of places and seasons.

and the best kind of natural character traits: see especially *Pr.* 30.1 on how diseases result from having too much black bile in one's mixture of the body and on how drinking wine changes that mixture and thereby produces different kinds of character traits.

Concerning character traits, we saw in the passage quoted above from *Politics* 7.7 that Aristotle also characterizes the—what I believe to be¹⁵—*material* natures of people living in different parts of the world as being either “one-sided” or “well-mixed,” and from the biological works we know that Aristotle uses the term “well-mixture” to characterize blood that is optimally balanced and that, in humans, this means that it is hot, pure (i.e., not earthy), and moist (see especially *GA* 2.6.744a30–31; *PA* 3.7.670b23–26; and *Sens.* 5.444a28–b7). Creatures with this kind of mixture Aristotle deems best (*PA* 2.2.648a9–11): “But those with hot, thin, and pure blood are best; for the ones that are such are at once in a good condition with regard to both courage and intelligence.”¹⁶ Roughly speaking, Aristotle believes that natural courage requires an appropriate level of heat in the blood (too much heat produces spiritedness, whereas a lack of heat produces timidity and cowardice, and both excesses and deficiencies in spirit cripple one's deliberative capacity and the ability to form friendships),¹⁷ whereas natural intelligence requires an appropriate level of moisture and purity of the blood (this type of blood makes the sense-organs soft and calm and therefore more receptive to sense-impressions, whereas too much “earth” in one's blood makes the sense organs hard and causes natural stupidity).¹⁸ Hence only men with blood that is hot, moist, and pure—which are apparently found predominantly in the intermediate regions of the world—possess the kind of well-mixedness of blood that makes them suitable for the life and training as future citizens of the ideal city.

15 Aristotle does not say explicitly in *Politics* 7.7 that it is the *material* nature of future citizens he is interested in, but this interpretation is consistent with Aristotle's earlier announcement that lawgivers should also take care of procuring the best material conditions for the future ideal city, which include its location and the quality of the men: see *Pol* 7.4.1325b39–1326a5.

16 For the causal relation between the material properties of blood and the kind of natural character traits animals have, see *PA* 2.2–4, especially *PA* 2.4.651a12–17: “it is reasonable that of many features the cause is the nature of the blood, both with respect to character among animals and with respect to perception: for it is the matter of the entire body. For nourishment is matter, and blood is the last stage of nourishment. It therefore makes a great difference whether it is hot or cold, thin or thick, turbid or pure.”

17 Heath (2008, 257–58).

18 See e.g. *DA* 2.9.421a18–26; *PA* 2.16.660a11–13; and *HA* 1.15.494b16–17.

That these men are found mostly in certain types of climates is no accident: Aristotle is explicit about the fact that environment can cause differences of the more and the less within the species-specific character profile of living beings (*HA* 8.29.607a9: “for regions produce differences also with regard to character traits”) and, just as the author of *Pr.* 14, he believes that this is due to a causal interaction between the mixture of the environment (τὸ περιέχον) and the material nature—which includes the blood—of the living beings that live in that environment (*Long.* 3.465b25–29): “The environment acts with or against [living beings]: and because of this, things that change become more or less enduring than their nature [warrants].”¹⁹ According to Aristotle, living beings are in the best material condition when the result of this interaction between the environment and the material nature constitutes a proportionate blend, that is, when it constitutes a stable balance between the contrary material potentials of the two mixtures involved. When this is the case, the living beings will be, among other things, healthy (*Phys.* 7.3.246b5–6), long-lived (*GA* 4.10.777b6–8: “the cause of whichever animal being long-lived is the being mixed—κεκράσθαι—in a manner resembling the surrounding air”), and fertile (*GA* 4.2.767a28–35):

And one region differs from another in these respects and one water from another water for the same reasons: for the food and the condition of the body become of a certain quality because of the mixture of the surrounding air (διὰ τε τὴν κράσιν τοῦ περιεστῶτος ἀέρος) and of the [food] entering [the body], and most of all because of the nourishment provided by water: for this is consumed most of all, and this [i.e. water] is present in everything as food, even in the solids. Because of this hard and cold waters produce sometimes infertility, sometimes the birth of females.²⁰

Aristotle believes that this kind of proportionate blend is achieved most easily when the environment is qualitatively most similar to the living being's own material nature (*Resp.* 14.477b14–17): “For contrary places and seasons preserve the [bodily] dispositions that have excesses, but the [material] nature is preserved mostly in their proper locations.” Thus, plants, which are constituted mostly from earth, thrive in the dry environment of the land; water animals, which are constituted mostly from water, thrive in the moist environment of the water; and winged animals and land animals, which are

19 Cf. *Phys.* 8.2.253a7–21 on how the environment constantly imparts motions on living beings.

20 See also *GA* 3.2.752b28–35.

constituted mostly from air and fire respectively, thrive in the warm environment of the air (*Resp.* 13.477a27–31 and 14.477b30–478a1). And, just as the author of *Pr.* 14.1, Aristotle believes that excessive conditions in the environmental mixture cause degenerations and distortions in the material natures of living beings, which can result, for instance, in their destruction, putrefaction, or in their becoming diseased (cf. *Pr.* 1.909a15–16: αἱ δὲ ὑπερβολαὶ with *GA* 4.10.777b28–30; see also *Mete.* 4.1.378b27–379a14 and *HA* 8.12–17 where Aristotle mentions the extreme conditions of climate as causes for animal migration in order to avoid death).

In sum, both *Pr.* 14 and Aristotle share very similar assumptions about mixtures and their interaction: it characterizes both the material properties of the environment and of the material natures of living beings; the “best” mixture of the environment is somewhere intermediate between the excesses of heat and cold (and possibly, moistness and heat); and this environmental mixture is best because it promotes the balance of the material nature of the living beings who are surrounded by that environment; and, finally, this kind of well-mixedness of the blood is thought to produce positive natural attributes, such as health and strength, natural courage, or intelligence. Now, of course, some of these ideas are not unique to the Peripatetic tradition. For instance, in the *Timaeus* (24c5–d3), Plato suggests that Athena chose the specific location for her city on the grounds that it had a “well-mixedness of seasons” (c6: τὴν εὐκρασίαν τῶν ὥρων), such that it would produce “the most intelligent men” (c7: φρονιμωτάτους ἄνδρας) and men that are lovers of war and wisdom just like her.²¹ Furthermore, in chapter 12 of *Airs Water Places*, the Hippocratic author identifies “the mixture of the seasons” (12.10: ἡ κρήσις τῶν ὥρέων) as the cause for the differences in beauty, size, and character traits of the people and other living beings located in Europe and Asia. In addition, he singles out the mixture of the seasons belonging to the region that lies in between the heat of the east and the cold of the west as being responsible for the favorable conditions in the part of Asia that is presumably to be identified as Ionia (12.10–11 and 12.14: ἐν μέσῳ), while blaming seasons that are not well-mixed as the causes of bodily distortions and negative character traits (24.24–27; 24.25: οὐκ εὐκρητα). And finally, Herodotus claims that while the most remote regions have drawn the most beautiful things as their lot, Greece—as perhaps lying in between these remote regions—acquired “by far the most beautiful seasons” (3.106.2–3; 3: τὰς ὥρας πολλόν τι κάλλιστα). However, I believe that the *nature* of the causal

21 Cf. Eur. *Med.* 827–41, where the chorus describes the Athenians as feeding upon “the most glorious wisdom” and as “always gracefully stepping through the brightest air,” and Athena as having blown “temperate (μετρίας) and sweetly blowing winds” on the land.

explanations that are offered in *Pr.* 14 is closer to the patterns of explanation that can be found elsewhere in Aristotle than to the patterns of explanations represented in the (roughly) contemporary medical and historical traditions, so let me turn to those causal explanations next.

4 Explaining Ethnic Properties

The types of causal explanation that are offered in *Pr.* 14 as possible answers to the puzzles about how environment influences the character traits and bodily features of people living in that environment are, as I will show below, very similar to the type of material-efficient explanation Aristotle offers for the physical differences of the more and the less in the attributes of living beings as produced by environment in *GA* 5. I will first discuss the explanations offered regarding differences in ethnic character traits and then turn to those concerning bodily features.

4.1 *Material-Efficient Explanations of Differences of the More and the Less in Ethnic Character Profiles*

Among the chapters in *Pr.* 14 dealing with ethnic character profiles, 8, 15, and 16 offer the most explicit causal explanations for why extreme environmental heat or cold correlate with specific character traits, so I will focus mainly on these chapters (*Pr.* 14.¹²² mentions, but does not explain, the effects of

22 Even though *Pr.* 14.1 does not make use of Aristotelian explanations, the language used to describe the influence of environment on intelligence seems distinctly Aristotelian to me:

First, “beastlike” as a characterization of someone’s intellectual capacities (909a13: θηριώδεις τὰ ἔθνη) recalls Aristotle’s remark in *EN* 7 that “beastlikeness” (which is one of the three moral dispositions one ought to avoid) is a rare condition that is mostly found “among foreigners” (although it can also be produced “by disease or maimings”; see *EN* 7.1.1145a15–32). Later, Aristotle also uses the term to describe cannibals who live near the Black Sea, mentions that it is an excessive disposition, and associates it with a kind of natural stupidity found among foreigners (*EN* 7.5.1148b15–24).

Second, the “degenerations” of body and thought that result from extreme conditions of the environment (909a16: ἐξιστᾶσι) are perhaps similar to the degeneration of characters as expressed in Aristotle’s *Rhetoric* (2.15.1390b21–31): “Good birth” is in accordance with the excellence of the stock, but “being true to one’s descent” (γενναῖον) is in accordance with not degenerating from [one’s] nature (κατὰ τὸ μὴ ἐξιστᾶσθαι τῆς φύσεως). . . . Naturally talented stock degenerates into more manic characters (ἐξιστᾶται δὲ τὰ μὲν εὐφυῶ γένη εἰς μανικώτερα ἢθνη), such as for instance the offspring of Alcibiades and of Dionysus, and steady [stock degenerates into] stupidity and dullness, such as for instance the offspring

environmental mixture on intelligence). Two types of causal explanations are offered: I will first discuss the physiological explanation and next turn to the psychological-historical one.

Generally speaking, the physiological explanations posit a compensatory²³ relation between the material properties of the environment and the internal material nature of people, according to which cool environments produce extra heatings of the material nature of the people living in those environments, while hot temperatures produce a cooling, and postulate that extra hotness of body or nature produces courage, while coolness produces cowardice. As for how exactly this heating or cooling of the material nature of people is caused, two interpretations are available.

First, the changes in the bodily “temperature” of people could be caused by a kind of activity of the material nature itself, which counterbalances or compensates for the extremities in the surrounding environment, as is suggested in the explanation in *Pr.* 14.15 of why people in hot regions are wiser than those in cold regions (910a27–32):

Is it because of the same factor because of which also the old [are wiser] than the young? For some, since because of the coldness of the region *their nature rises up*²⁴ (ἐπανιούσης τῆς φύσεως), are much hotter, such that they resemble those who have drunk too much, and they are not investigative but courageous and optimistic (οὐκ εἰσὶ ζητητικοί, ἀλλὰ ἀνδρείοι καὶ εὐέλπιδες). Others in hot regions are sober because of having been cooled (διὰ τὸ κατεψύχθαι).

Material natures, on this reading, actively preserve the living beings of which they are part by producing a kind of proportionate mean between the environment and themselves: if the temperature of the environment goes down, the material nature pushes its own temperature up, and vice versa, and this in turn leads to differences in the level of courage or cowardice of people.²⁵ This

of Cimon, Pericles, and Socrates.” On degenerating characters, see also *HA* 1.1.488b11–21, and for “degeneration” as a mechanism in Aristotle’s theory of inheritance, see *GA* 4.3.

²³ Heath (2008, 254 n. 24).

²⁴ Mayhew (2011, 447) translates “because their nature resists owing to the coldness of the place,” but I believe that “rising up” is a better translation of ἐπάνειμι in this context; cf. *Pl. Tim.* 22e2–4, who uses the verb to describe how in Greece, water, instead of raining down from above, tends to “naturally well up from below” (κάτωθεν . . . ἐπανιέναι πέφυκεν).

²⁵ See Mayhew (2011, 449 n. 27) who makes a similar suggestion for the interpretation of *Pr.* 14.15.

interpretation also fits—at least at first sight—with the first part of *Pr.* 14.8 (909b10–13):

Is it because [one's] nature is opposite to regions and seasons, because if [one's nature] were in the same condition it would necessarily quickly be consumed (διὰ τὸ ὁμοίως ἐχόντων ἀνάγκη διακαίεσθαι ταχέως)? And the ones who are hot with regard to their nature are courageous, while the ones who have been chilled are cowardly.

What appears to be responsible for the preservation of people according to this account is again the fact that material natures are somehow able to take on the contrary material quality from the one that dominates the environment. This type of explanation, however, is rather un-Aristotelian, as Aristotle never describes material natures as being active in that way (if anything, this would be the goal-directed work of a *formal* nature: cf. *Cael.* 2.12.293a2 on nature as a kind of equalizer—ἀνισάζει ἢ φύσις—and producer of order). The only passage in Aristotle that—as far as I can tell—would support such an active, compensatory role of material natures, quotes a view from someone else²⁶ (*PA* 2.2.648a25–26): “For some say that the water animals are hotter than the land animals, saying that the the heat of their nature equalizes the cold of their location (λέγοντες ὡς ἐπανισοῖ τὴν ψυχρότητα τοῦ τόπου ἢ τῆς φύσεως αὐτῶν θερμότης).” In passages that represent Aristotle's own views, it is in fact the environment that acts as a kind of—accidental—equalizer (*Resp.* 14.478a1–4):

However, concerning the dispositions [of the body], the ones that are extremely hot are saved (σώζονται) more in a cold environment, whereas the ones that are in a cold condition are [saved more] in a hot environment, for the region equalizes the excess of the disposition to an appropriate degree (ἐπανισοῖ γὰρ εἰς τὸ μέτριον ὁ τόπος τὴν τῆς ἕξεως ὑπερβολήν).²⁷

26 Presumably Empedocles: cf. Theophrastus, *CP* 1.21.5.8–6.1: “A second cause is [the quality] of the region (for example its being cold), for opposites are capable of persisting in opposite [regions], some persisting in hot [regions], others in cold [regions]. For this way is also how nature generated them from the outset, since they are killed by a similar [condition] due to the excess, while being preserved by an opposite [condition], as there comes to be a kind of well-mixedness, as also Empedocles says about animals: for nature brings to water the ones that are excessively fiery.”

27 Cf. *Resp.* 14.477b14–17 quoted above and *Pr.* 1.11.860b8–14, where the fact that the dryness of the summer and fall can bring about a well-mixedness of the material natures of phlegmatics and women (who normally suffer from permanent wetness) is explained by

However, the remainder of ch. 8 suggests that perhaps the author of *Pr.* 14 does not actually believe that material natures are such active, compensatory principles either (909b13–15): “And it happens that those living in hot regions are chilled, while those in cold regions are heated up with regard to their nature (συμβαίνει δὲ τοὺς μὲν ἐν τοῖς θερμοῖς ὄντας κατεψύχθαι, τοὺς δὲ ἐν τοῖς ψυχροῖς ἐκτεθερμάνθαι τὴν φύσιν).” In this section, the material natures are conceptualized as the *patients* in this process of change, while the heat and the cold of the environment act as the efficient causes activating this change: the heating and cooling of natures is something that *happens to* those natures.

This second, alternative causal explanation is more explicit in ch. 16 (910a38–910b9), which is otherwise largely identical to ch. 8:²⁸

Why are those in hot regions cowardly, while those in cold ones are courageous? Is it because [one’s] nature is in an opposite condition to regions and seasons, BECAUSE IF [ONE’S NATURE] WERE IN THE SAME CONDITION IT WOULD QUICKLY BE CONSUMED (διὰ τὸ ὁμοίως ἐχόντων διακάεσθαι ἂν ταχέως)? And the ones who are hot with regard to their nature are courageous, while the ones who have been chilled are cowardly. And it happens THEREFORE (δὴ) that those living in hot regions BECOME CHILLED (καταψύχεσθαι)—FOR BECAUSE THEIR BODY IS POROUS, THEIR HEAT ESCAPES TO THE OUTSIDE (ἄραιον γὰρ ὄντος αὐτοῖς τοῦ σώματος τὸ θερμὸν αὐτῶν ἔξω διεκπίπτει), while those in cold regions are heated up with regard to their nature ON ACCOUNT OF THEIR FLESH BEING THICKENED DUE TO THE EXTERNAL COLD, AND BEING THICKENED IT WRAPS UP THE HEAT INSIDE (διὰ τὸ ἐκ τοῦ ἐκτὸς ψύχους πυκνουσθαι τὴν σάρκα, πυκνουμένης δὲ ἐντὸς συστέλλεσθαι τὸ θερμόν).

In this chapter, the addition of the particle *δή* suggests that the account following “and it happens” is supposed to explain how one’s nature ends up in the opposite condition to the seasons. The reason why natures become heated or chilled is that the external temperatures produce material-efficient changes in the skin of those who live in those conditions: environmental heat makes the skin porous, causing internal heat to escape, and thereby the heat of the internal material nature to go down, while environmental cold thickens the skin, trapping the internal heat inside and making the heat of the internal, material nature go up. People’s material natures, then, compensate for extremities in

reference to seasons “pulling” their natures—which are both excessive in one direction—“into the opposite direction.”

28 The passages in SMALL CAPITALS are the ones that are different from the text in ch. 8.

their environment by a form of material necessity that is initiated by the environment itself and not by their material natures.

This latter type of explanation is very much like the explanations Aristotle offers in *GA* 5, where he deals with the differences of the more and the less in the attributes of animals that mostly come to be during the later development of (human) animals after birth and that are often *not realized uniformly* in all living beings that possess them and sometimes not even within one and the same species. These include differences of the more and the less produced by environment, such as, for instance, differences in the structure of the hair between Scythians and Thracians who live in moist environments on the one hand and the hair of Ethiopians who live in dry environments on the other hand (3.782b32–783a1; see my discussion below), differences in the pitch of voice of animals living in cold versus hot environments (7.788a16–20), a change in color in the feathers of birds and hairs of wild quadruped due to changes in the season (6.786a30–34), as well as differences in the quality of hearing produced by moist climates and mixtures (2.781a30–34). Aristotle's explanation for why human hair is affected differently by climate from that of sheep is especially relevant (3.783a12–32):

Sheep living in cold climates (ἐν τοῖς ψυχροῖς) suffer the opposite from humans: for the hair of Scythians is soft, but the hair of Sarmatian sheep is hard. And the cause (αἴτιον) of this is the same as with regard to all wild animals. For the cold hardens them through thickening (πηγνύουσα), on account of the drying; for as the heat is pressed out the moisture evaporates and the hair and skin become earthy and hard. The cause of this is in wild animals their open air life, but in others the quality of the location (ὁ τόπος τοιοῦτος) they are in. A sign of this is also what happens to sea-urchins. . . . [Their spines] are hard and have turned into stone because of the cold and the coagulation. In the same way, also other plants turn out harder and earthier and stonier when they come to be in areas exposed to northern winds than when facing southern winds. . . . For they are all more chilled and their moisture evaporates.

As in the example from the *Problems*, Aristotle describes the cold of the environment as having a hardening and thickening effect on the parts of the body exposed to that environment. And, just as in the *Problems*, the phenomenon to be explained—a difference of the more and the less in an affection of a feature that belongs to all members of the same species—does not require any teleological explanation but can be accounted for solely in terms of material-efficient causes.

Now contrast these explanations with the ones offered in the Hippocratic *Airs Water Places*. One the one hand, the author of this treatise agrees with Aristotle and the author of *Pr.* 14 that moderate material properties of the environment are most conducive to certain favorable properties of the living beings that live in that environment. For instance, about Asia, the author states (*Aërs* 12.7–13; 27–29):

For everything in Asia comes to be much more beautiful and larger: for the one region is milder than the other, and the characters of the people are milder and gentler. And the cause of this is the mixture of the seasons, because it lies in between rising of the sun towards the east and further away from the cold. It provides growth and mildness most of all where there is nothing that dominates by force, but where equability prevails over everything (ὁκόταν μηδὲν ἢ ἐπικρατέον βιαίως, ἀλλὰ παντὸς ἰσομοιρὴ δύναστέυη). . . . It is plausible that this region is very close to the spring with regard to the nature and moderateness of its seasons (τὴν μετριότητα τῶν ὥρέων).

On the other hand, as is also clear from this passage, what the Hippocratic author believes is truly the cause of those favorable properties of the people and plants that live in between the hot and cold regions is the fact that that region is characterized by a *serene and homogeneous climate* (see *Aërs* 12.14: ὁμοίως), that is, by a climate that does not possess many violent changes. The causal relation between the climate and the properties of the bodies and characters of the people that live in that climate can be characterized as one of sympathy rather than one of compensation:²⁹ the gentler and more even the climate is, the gentler and more uniform the inhabitants are in both character and physical appearance, whereas the greater and the more violent and the more frequent the changes of the seasons are, the more courageous or warlike and physically diverse the inhabitants are (see *Aërs* 13.3–17 [4–5: διὰ τὰς μεταβολὰς τῶν ὥρέων]; 16.3–4; 23.2–5; and 24, *passim*). Because of this, intermediate and serene climates are incapable of producing courage (*Aërs* 12.29–31 and 16.1–9), which is instead instilled through “shocks to the mind” (16.5 and 23.15–16) produced by frequent and violent changes of the seasons, which act as a kind of “training program” of both body and mind. This difference in “training,” then (and not the effects of material-efficient causation on the body as in

29 Sassi (2001, 109).

Pr. 14 and Aristotle),³⁰ is the reason why the Europeans are stronger and more courageous than the Asians: the bodies and minds of the Europeans are constantly changed and hardened through the seasons, whereas the Asians are left at peace (16.1–11; 23.1–23; and 24, *passim*). In addition, unlike the author of the *Problems*, the Hippocratic author likes to juxtapose the influence of climate with that of laws and constitutions, which can produce the same effects (16.11–27 [11: καὶ προσέτι διὰ τοὺς νόμους]; and 23.23–31).³¹ And finally, the Hippocratic author does not mention how environment might affect the *intellectual* capacities of the people living in those environments; *Airs Water Places* only deals with what we would call “personality” traits, while the author of the *Problems* (as well as Aristotle)³² includes intellectual traits in the character profiles that are affected by the environment.

Herodotus appears to accept a very similar account of how climate influences character as is presented in *Airs Waters Places*. Although for the most part Herodotus emphasizes the role of law or custom over nature, the last chapter of his *Histories* includes an anecdote about Artembares and Cyrus, king of the Persians. Artembares suggests to Cyrus that the Persian people leave the rugged land on which they live now and find a region that is better. Cyrus does not like the plan, and replies (9.122.12–17):

Do this, but by ordering this advise them to be prepared to no longer be rulers but instead be ruled. For from soft lands soft men tend to come to be (φιλέειν γὰρ ἐκ τῶν μαλακῶν χώρων μαλακοὺς ἄνδρας γίνεσθαι): for it is not possible that from the same soil both amazing fruits come to be and men who are good at war.

30 See, however, *HA* 8.29.607a9–13, where Aristotle discusses how differences in regions produce differences in the character traits of animals and states that animals living “in rugged highlands will be different from those living in the soft lowlands,” as the former will be “fiercer and bolder in their appearance.” Although Aristotle does not provide any causal explanation for this, the suggested correlation between the ruggedness of the environment and the toughness in character is very similar to the explanations that dominate the Hippocratic *Airs Waters Places*.

31 This type of explanation is also different from Aristotle’s, who (as we saw in *Pol.* 7.7.1327b18–38 quoted above) suggests a different causal relation between constitutions and natural character traits: for Aristotle, climate produces changes in natural character traits and these different character profiles produce differences in the natural ways in which people organize themselves and their cities. (Of course, Aristotle also believes that laws and constitutions can change people’s character traits, but this is part of his program of moral development and not of ethnography.)

32 See especially *HA* 1.1.488b12–24 and 8.1.588a18–b3.

After hearing this, the Persians walk away, agreeing with Cyrus, and choose “to rule while living in a poor region over sowing the plains while being slaves to others.” The causal relation between climate and character in this anecdote is left implicit, but the idea that soft lands produce soft people and the implication that it is because of the harsh living conditions of the Persian people that they are so successful at warfare is very similar to the theory of environmental sympathy presented in the Hippocratic treatise.

In addition to these physiological explanations, the author of *Pr.* 14 also offers a closely related psychological-historical explanation for the “fact” that people living in hot regions are wiser than those living in cold ones (*Pr.* 14.15.910a29–37). On this account, people in cold regions have higher levels of internal heat, which makes them “resemble those who have drunk too much,” making them “not investigative but courageous and optimistic,” and so they inquire less, while people living in hot regions are like those who are sober and who are therefore scared rather than courageous, making them inquire more. The difference in wisdom thus does not reflect a difference in natural capacities but rather reflects how differences in personality traits (such as courage and cowardice) affect the investigative nature of people: those who inquire more are wiser because they discover more, and vice versa. As a second explanation, the author also suggests that this differentiation could be due to the longevity of those living in hot regions, while those living in cold regions have perished due to floods:³³ those living in hot regions are like old people who have had more time to acquire wisdom, whereas people in cold regions are like young people who die before having been able to acquire much wisdom.³⁴

The analogy used in this explanation between the wise people who live in hot regions and those who are sober or old on the one hand and between the less wise people living in cold regions and those who are drunk or young on the other hand, as well as the personality traits associated with them, is again one that could well be Aristotelian in origin. For in his *Rhetoric*, while provid-

33 References to historical floods destroying humans are also present in Plato (see, e.g., *Leges* 677a4–6: “... that there have been many destructions of humans through floods and diseases and many other things, in such a way that only a small portion of the human race has survived”; *Leges* 679d2; and *Tim.* 25c7) and Aristotle (*Phys* 4.13.222a22–26).

34 Potential explanations for why people in hot regions live longer are provided in *Problems* 14.9–10: aging is either a form of putrefaction or of cooling of the internal heat or of drying, and people living in hot regions are either drier and therefore more difficult to putrefy, or are less quickly or less likely cooled, or are better at preserving their heat and moisture.

ing character profiles of the young, the old, and the men who are in the prime of their life (2.12–14), Aristotle, too, compares the young with those who have drunk too much (2.12.1389a18–19: “just as men overcome by wine, so too are young people thoroughly heated—διὰθερμoί—by their nature”) in describing the hotness of their nature,³⁵ which in its turn explains their courage and optimism (2.12.1389a25–26: ἀνδρείότεροι... εὐέλπιδες).³⁶ And although Aristotle does not characterize the old as sober, he does explain their cowardly character traits in terms of the coldness of their nature (2.13.1389b29–32: “for they are cowardly and always anticipating danger. For their states are the opposite from that of the young: for they are cold, whereas [the young] are hot, such that old age has paved the way for cowardice—for fear is a kind of chilling”). There are no such analogies in either the Hippocratic *Airs Waters Places* or in Herodotus’ *Histories*.

4.2 *Material-Efficient Explanations of Differences of the More and the Less in Ethnic Bodily Features*

The explanations that are offered in *Pr.* 14.4, 8, and 14 for differences of the more and the less in the bodily features of certain ethnic groups—i.e. bowleggedness, curly hair, tallness, and dark eyes in the case of people living in hot regions and tallness and blue eyes in the case of people living in cold regions—are similarly couched in the Aristotelian language of material-efficient causation and are exactly the kinds of differences of the more and the less Aristotle sets out to explain in *GA* 5 (differences in eye-color especially are used as an example of something that needs to be explained in terms of “the matter and the source of motion as coming to be from necessity”: see *GA* 5.1.778a17–20 and 778a29–b1).

For instance, in explaining the bowleggedness of Ethiopians and Egyptians, the author of *Pr.* 14.4 draws an analogy between what happens to wooden beams when they are being dried out under the influence of heat and what happens to the bodies of animals under similar conditions: they both get warped (909a28: διαστρέφεται).³⁷ As evidence for this explanation the author points to the fact that their hair is curlier as well, and curliness is “like the

35 Cf. *EN* 7.14.1154b9–10: “Similarly, in youth, people are—because of the growth that is going on—in a bodily condition similar to those who are drunk...”

36 On the effects of drinking wine on character in Aristotle, see also *HA* 7.5.585a32–33, 8.12.597b27–29; and *EE* 3.1.1229a18–20.

37 See also *EN* 2.9.1109b1–12, where Aristotle compares the habituation of men with the straightening of bent sticks.

crookedness of hair” (909a30–31: ὥσπερ βλαισότης τῶν τριχῶν).³⁸ In both cases, the drying heat causes the bodily parts to twist immediately, without first changing the internal heat or the material nature of the people in question.³⁹ This is also very similar to how Aristotle explains differences in the straightness and curliness of the hair of different ethnic groups (GA 5.3.782b32–783a1): according to Aristotle curly hair is harder than straight, because dry things are harder than moist things, and Ethiopians and people in hot countries have curly hair because “their brains and the surrounding air are dry.” Environmental heat thus causes hair to dry out from the outside, such that it becomes curly of material necessity, without necessarily also changing the mixture of the material nature of people, even if the dryness of the latter is also due to the heat of the environment.

Similarly, in explaining the tallness of people living in both cold and hot regions in *Pr.* 14.8.909b15–24, the author states that in *both* cases this is due to heat. For cold regions produce hotter internal natures, such that these people possess “an extreme source of growth,” while hot regions do not from the outside impede the growth of the people living there, even if their source of growth must itself be smaller. Only “in the region around us” is the source of growth smaller and is the growth tempered by the external cold, thereby causing the people living there to be less tall. Although structurally this explanation is thus very similar to material-efficient type explanations that are especially common in GA 5, it actually conflicts with the explanation Aristotle himself provides for the tallness of people. For according to Aristotle, only people (and animals) living in hot regions are tall, and this is caused by the hot humidity of the environment, which feeds the life-giving internal heat and moisture of living beings and thereby enhances their size (and longevity), whereas cold environments easily congeal moisture and thereby inhibit the growth (and longevity) of the people living there, especially since their moisture is already more watery due to the coldness of the environment (*Long.* 5.466b16–22).⁴⁰ In other words, both authors agree that heat produces growth while cold inhibits it, but Aristotle adds moisture as a second causal factor to his explanation (for moisture is according to him “life-giving”: GA 2.1.733a11) and holds that the two factors combined explain the tallness and longevity of people living in

38 Cf. *IA* 16.713b9–10 on the crookedness of the legs of non-blooded polypods.

39 Contrast, however, *Pr.* 38.2: there dryness of the environment is taken to be the cause of the reddishness and thinness of the hair of people living in the north.

40 Aristotle also believes that environmental coldness can make it *entirely* impossible for certain kinds of animal to come to be: see *Long.* 5.466b22–28; *HA* 8.28.605b22–24 and 606b2–3; and *GA* 2.8.748a22–26.

hot regions. Interestingly, the Hippocratic author of *Airs Waters Places* also appears to explain tallness more in terms of the moisture of the environment rather than in terms of its heat (e.g., the Phasians who live in foggy marshes are “tall in stature”: *Aërs* 15.14; cf. 24.9–12), and sides with Aristotle in characterizing the Scythians (and animals living in Scythia) as short due to the coldness of their environment (*Aërs* 19.3–18). The explanation offered in *Pr.* 14.8 thus appears to be rather unique both in its attribution of tallness to people living in cold regions and in its explanation.

And finally, in *Pr.* 14.14, differences in the darkeness and lightness of eyes are explained *first* in terms of the presence or lack of internal heat and the level of moisture that is present in the eyes as a result of internal heat being present or lacking, with the internal heat itself either being locked in or pressed out of the eyes due to the surrounding heat or cold. Because of this, people in the north are blue-eyed due to an excess of internal heat present in the eyes that is locked in there by the environmental cold, while people in the south are dark-eyed due to the lack of internal heat in the eye (the environmental heat causes their internal heat to escape) *as well as* to the leftover moisture in the eye (which is locked in there because of the external heat). Ultimately, it is the leftover moisture taking over the space where otherwise there would be fire or light that causes darkness of the eye. The author attributes this view to Empedocles, and the explanation indeed fits broadly with Aristotle’s version of Empedocles’ explanation of the differences of the more and the less in eye-color in *GA* 5.1.779b15–20, which postulates that blue eyes have more fire than water (and therefore see better at night) while dark eyes have more moisture than fire (and therefore see better during the day). Aristotle himself, of course, criticizes this view and claims that these differences are *solely* due to differences in the level of moisture in the eye (much liquid causes darkness and makes the eye move less easily under the influence of sense impressions, while little liquid produces blueness and makes the eye move more easily: see *GA* 5.1.779b14–780a13). Thus, while in this case Aristotle might have formed the *source* for explanation presented in *Pr.* 14.14 (cf. *Sens.* 2.437b9–438a4), it is not his own view that is preserved.

The same is true for the second, alternative explanation that is presented in *Problems* 14.14, which simply posits that there is a correspondence (910a22: ὁμοιοῦται) between the color of the eyes and the color of the rest of body, but without offering a further explanation for why this correspondence should hold. The assumption that because their skin is black, other bodily parts of the Ethiopians will be black as well, appears to be a more common one: for instance, in a different problem, the author is puzzled about the fact that Ethiopians have very white teeth, but black nails, and postulates that while

nails grow from the skin and therefore have the same color, teeth are dried and thereby turned white by the sun (*Pr.* 10.66); and Herodotus makes the surprising claim that the Ethiopians have black semen (3.101.4–7). Again, this is not a view endorsed by Aristotle,⁴¹ as we already saw above; and although he does believe that the color of hair and feathers *in non-human animals* is caused by the material nature of the skin, such that white skin produces white hair etc., he does not think that this causal relation applies to humans (*GA* 5.4.784a23–26 and 5.5.785b2–15).

In sum, then, the problems collected in *Pr.* 14 offer a wealth of ethnographical material that is clearly much indebted to the debates about the relation between environment and ethnic traits in the philosophical, medical, and historical treatises of the time, and, as I have argued, especially—but not uniquely—to Aristotle's views.

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⁴¹ Aristotle criticizes Herodotus's claim in *HA* 3.22.523a17–18 and *GA* 2.2.736a10–13: "Herodotus did not speak the truth when he claimed that the semen of the Ethiopians is black, as if it were necessary that because the color of their skin is black everything should be black..."

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Problemata 15: Its Title and Agenda

Alan C. Bowen

1 The Title of *Problemata* 15

There is a variety of titles for this book in the surviving manuscripts as well as in our modern editions and translations, a fact which ultimately signals the difficulty of interpreting the *problemata* within book 15 and discerning the principle of their collocation. This uncertainty is evident even in the earliest manuscript witness (designated Y^a), which is found in the codex Parisinus graecus 2036. Nevertheless, I propose that this manuscript also indicates an understanding of book 15 that grasps its coherence in an interesting way.

The Earliest Witness

Parisinus graecus 2036 was written in the 10th century and thus some 200 years before the next surviving copy of the *Problemata*. It is singularly important not only for its antiquity but also because it is complete, well preserved, and a source consulted by several later readers and annotators.

The original layout of the pages is straightforward: there is the body text and to the left in the margin are given the numbers of the *problemata* themselves. In another hand, in the far left or far right margins are given the book numbers.¹

To punctuate Y^a, the copyist uses the following signs:

- + a cross placed at the left margin to mark a major division and the beginning of new text, usually the title of a book, as well as on occasion the end of this text when placed at some distance from it on the same line (see, e.g., f. 93v)
- : a dicolon to separate text, occasionally one *problema* from another (see, e.g., f. 93v) or the title of a book from its first *problema* (see, e.g., ff. 135v, 139r, 175v)
- :- a dicolon with paragraphos (–) to mark the start of a textual unit

¹ Louis (1991–1994, 1: xli) reports only that the book numbers are in the right margin and says nothing of the hand. In my digital image of the codex, however, the ink for the book numbers is quite faded but still appreciably more black than that of the body text and numbers for the *problemata*, and the letters are not that well formed.

- ∴ a dicolon with coronis (∴) to mark the end of a textual unit, usually the last *problema* in a book
- an upper point to conclude an independent textual unit, be it a book title (see, e.g., f. 124r), some text within a *problema* (where we might use a colon, a period, or a question mark), or a *problema* (all but the last *problema* in book 15 conclude with an upper point), as well as to separate items in a list
- a lower point to conclude a dependent textual unit (where we might use a comma).

One also finds written in another hand (Y^{a3})² within each *problema* in the left margin:

- ~ a paragraphos to mark a major transition such as that from the leading question of a *problema* to a secondary question (see Plate 4).

In addition to these conventions, it is important to notice some features of this copyist's engagement with his text.³ First is that he is not a mere copyist but does on occasion intervene in Y^a to correct careless mistakes.⁴ Next is that he starts the opening text (usually a title) of a new book of *problemata* on a new line. And last is that he does not always follow this practice in dealing with the *problemata* within a book. The rule here is to end the sentence of the concluding *problema* with an upper point (·) and then, after a blank space of two to

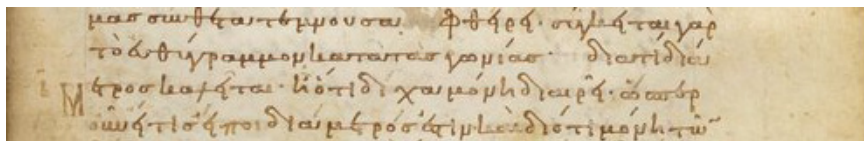


PLATE 1 The transition to Pr. 15.2 (Par. gr. 2036f. 89r)

(REPRODUCED BY PERMISSION OF THE BIBLIOTHÈQUE NATIONALE DE FRANCE)

2 According to Louis (1986, 199; 1991–1994, 1: xlii), this hand dates from the early 16th century: he describes the writing as thick, clumsy, with letters that are more slanted, and in ink that is much faded. So far as I can judge from my digital image of the codex, this hand may also be responsible for the book numbers in the left or right margins beside the book titles: see, e.g., Plate 3.

3 Cf. Louis (1991–1994, 1: xli–xlii).

4 According to Louis (1986, 199 n. 10), there are four instances in which the copyist makes such corrections: his edition (1991–1994), however, shows only three—all in book 10 (891b11, 891b19, and 891b32).

three letters, to fill out that line if possible with the first sentence of the next *problema* and, when this continues into the next line, to capitalize the letter at the start of this line—no matter where it occurs in the word (see Plate 1).

The Table of Contents

Let us turn first to the listing on f. 1r of the contents of the *Problemata*. This listing is displayed in four columns written in two hands. Columns 2 and 3 are in the copyist's hand: the second gives book numbers and the third, the book's title in some form. Columns 1 and 4 are in the hand of the annotator/redactor Ya2:⁵ the first, which is lacunose and difficult to read, may correlate the book numbers of the second column with those of another collection or arrangement of the *Problemata*. Column 4 gives the number of *problemata* in each book. So far as one can tell from this table of contents, the reckoning of *problemata* in this last column usually accords with that of our modern editions but sometimes it does not.⁶

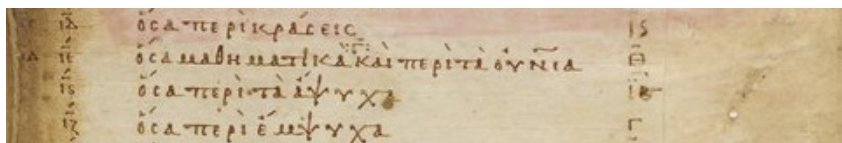


PLATE 2 *Contents of book 15 (Par. gr. 2036 f. 1r)*

(REPRODUCED BY PERMISSION OF THE BIBLIOTHÈQUE NATIONALE DE FRANCE)

Plate 2 shows the entry for book 15, which I transcribe and translate provisionally as follows:

- 5 Louis (1986, 199); (1991–1994, 1: xlii) dates this hand to the 12th century and describes its ink as very black, that is, blacker than the reddish black ink of Y^a. Unlike the copyist of Y^a, Y^{a2} puts a diaeresis over «ι» (“io”) in columns 1 and 4; and, in his abbreviation of «περί», the horizontal stroke in «Π» stops at the vertical strokes.
- 6 A few of the original entries in column 4 on ff. 1r–v have been corrected and are now in accord with our modern editions; but some are still not—e.g., book 15 is listed as having 12 *problemata* rather than 13; book 25, with 21 *problemata* and not 22; and book 26, with 61 not 62. The count in book 15 of Y^a derives from the combining of our 15.3 and 15.4 in *problema* 3. In book 25, *problema* 12 combines our 25.12 and 25.13; and in book 26, *problema* 10 combines our 26.10 and 26.11.

		:Γ̄:	
ιδ	ιε'	ὅσα μαθηματικά καὶ περὶ τὰ οὐ(ρά)νια	Θ
		3	
14	15	All the [<i>Problemata</i>] that are Μαθηματικά and [all that] concern the Celestial Bodies ⁷	9

The Insertion after Book 14

This is not, however, what one finds at the close of book 14 and before the start of *problema* 15.1. There one finds inserted after the last word of book 14, «θερμόν», a text which I transcribe as follows (see Plate 3):

θερμόν:~ <textual ornaments>
 + τὰδε ἔνεστιν ὅσα μαθηματικῆς μετέχει θεωρί
 ας ἀπλῶς · καὶ ὅσα περὶ τὰ οὐράνια · ὅσα περὶ τὰς
 ἄψυχας · ὅσα περὶ τὰ ἔμψυχα: – ὅσα μαθηματικά:~

Note that in «μαθηματικῆς», the «η» in the final syllable is a correction in another hand, perhaps Y^{a3}, given the inclination of the vertical strokes of the «H».

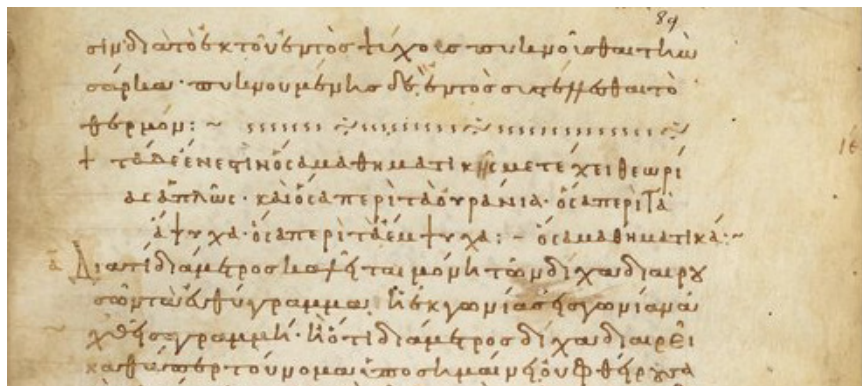


PLATE 3 *Heading for book 15 (Par. gr. 2036 f. 89r)*
 (REPRODUCED BY PERMISSION OF THE BIBLIOTHÈQUE NATIONALE DE FRANCE)

7 In this listing, «οὐ(ρά)νια» is written as a *nomen sacrum*: «ΟὐΝΙΑ»

As Robert Mayhew (2012, 180 with n. 5) has rightly noted,

- «τάδε ἔνεστιν» announces a listing of contents,
- «ὅσα περὶ τὰ ἄψυχα» is the title of book 16, and
- «ὅσα περὶ τὰ ἔμψυχα», the title of book 17.

But it is not the case, as he supposes, that «ὅσα μαθηματικά» belongs to this list: note that it is separated from «ὅσα περὶ τὰ ἔμψυχα» by its enclosure between a dicolon with paragraphos and a dicolon with coronis. Moreover, if one recalls the table of contents for this manuscript (see Plate 2), it is clear that «ὅσα μαθηματικά» is far from redundant: it is, in fact, the first part of the listing «ὅσα μαθηματικά καὶ περὶ τὰ οὐ(ρά)νια» given for book 15 on f. 1r. The other part of this listing «περὶ τὰ οὐράνια» is found as «ὅσα περὶ τὰ οὐράνια» on f. 90r between *Pr.* 15.4 and 15.5 in our reckoning (see Plate 4). (In *Y^a*, however, these lines come between the third and fourth *problemata* because the exemplar lacked the leading question of our *Pr.* 15.4 and runs its secondary question into the third *problema* (see f. 89v).) In sum, «ὅσα μαθηματικά», by virtue of its position and its relation to the listing of contents on f. 1r, is actually the title of the first part of book 15.⁸

On f. 1r, *Y^{a2}* has inserted above «καί» (“and”) a «Γ» (“three”) to indicate that there are 3 + 9 or 12 *problemata* in book 15 (rather than our 13). More importantly, this also makes clear that the annotator/redactor *Y^{a2}* understood that the copyist of *Y^a* was actually reading an exemplar in which book 15 was divided into two coordinate parts, the first entitled «ὅσα μαθηματικά» and the

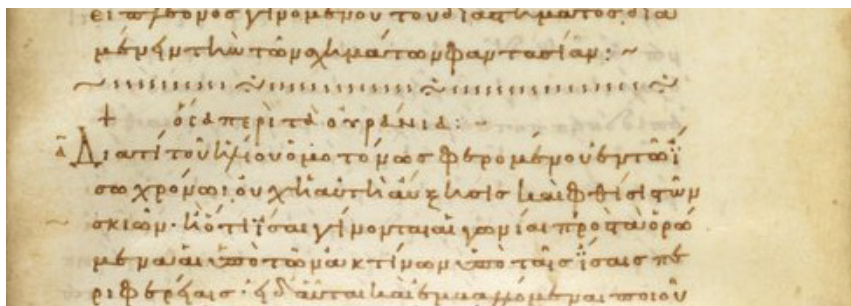


PLATE 4 *Heading between 15.3 (15.4) and 15.4 (15.5) (Par. gr. 2036 f. 90r)*
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⁸ Mayhew reached this same conclusion in a private communication of November 2012, a few months after the publication of Mayhew (2012).

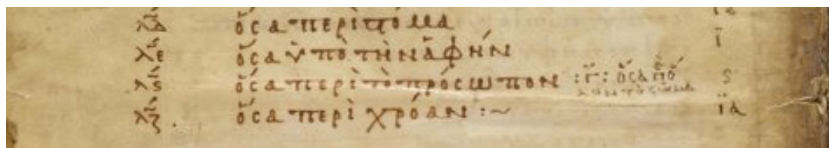


PLATE 5 *The listing for book 36 (Par. gr. 2036 f. 1v)*
(REPRODUCED BY PERMISSION OF THE BIBLIOTHÈQUE NATIONALE DE FRANCE)

second, «ὅσα περὶ τὰ οὐράνια». That the listing in column 3 of f. 1r has only «ὅσα μαθηματικά καὶ περὶ τὰ οὐ(ρά)νια» is not a real problem: it simply combines the two coordinate titles found in book 15.

Likewise, in the case of book 36, Y^{a2} has corrected the listing on f. 1v by indicating that it has three *problemata* and inserting the title, «ὅσα περὶ ὅλον τὸ σῶμα» and the numeral “6” (see Plate 5). That this inserted title is in fact coordinate would seem to follow given that

- it is assigned its own number of *problemata* on f. 1v,
- Pr. 36.3 (on f. 175r) is concluded by a dicolon with coronis followed by ornamental elements, and that
- this title, which is on a new line, is preceded by a cross and then followed by an upper point and another cross after a few spaces (see Plate 6).⁹

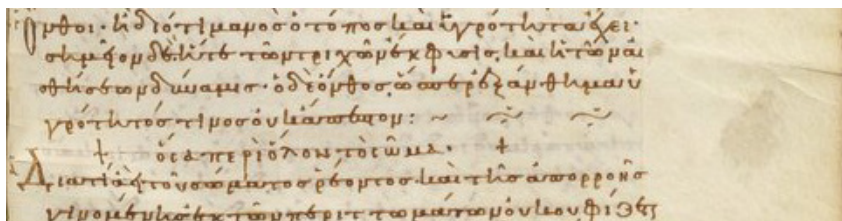


PLATE 6 *The coordinate title in book 36 (Par. gr. 2036 f. 175r)*
(REPRODUCED BY PERMISSION OF THE BIBLIOTHÈQUE NATIONALE DE FRANCE)

⁹ Note that the listing on f. 1v for book 36 abbreviates the title on f. 175r «Ἀριστοτέλους ὅσα περὶ πρόσωπον» to «ὅσα περὶ πρόσωπον». This coordinate part is now book 37 in modern editions, just as George of Trebizond, for example, assigned the *problemata* under «ὅσα περὶ τὰ οὐράνια» to their own book (numbered 16) in his Latin translation of 1452: see the copy, Parisinus latinus 6328, ff. 65v–66r and Plate 7.

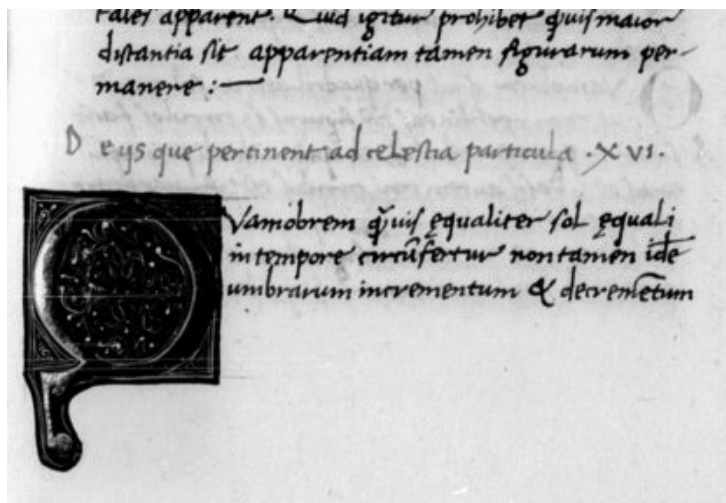


PLATE 7 The title of book 16 in George of Trebizond's translation (Par. lat. 6328 f. 66r)
(REPRODUCED BY PERMISSION OF THE BIBLIOTHÈQUE NATIONALE DE FRANCE)

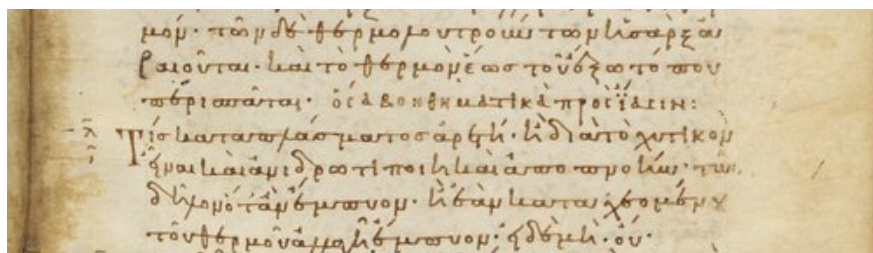


PLATE 8 The subtitle in book 1 (Par. gr. 2036 f. 8r)
(REPRODUCED BY PERMISSION OF THE BIBLIOTHÈQUE NATIONALE DE FRANCE)

This would mean, then, that books 15 and 36 are unique in this respect. Book 1 does indeed present a title, specifically, «ὅσα βοηθηματικά πρὸς ἰασιν» (“All the [*Problemata*] that are Useful for Healing”), between 1.29 and 1.30 (see Plate 8). But not only is this title preceded only by an upper point and followed by dicolon alone, it lacks the initial cross (and a closing one as well). Moreover, the numeration of the *problemata* does not start over after «ὅσα βοηθηματικά πρὸς ἰασιν» but continues in sequence. In addition, the listing for book 1 on f. 1r has only «ὅσα ἱατρικά» (“All the Medical [*Problemata*]”): there is no mention of this second title or part and it is not assigned its own number of *problemata*.

Accordingly, I conclude that «ὅσα βοηθηματικά πρὸς ἴασιν» was, for both the copyist of Y^a and his redactor Y^{a2}, the title of a subordinate, not a coordinate, part.¹⁰

2 The Agenda of *Problemata* 15

So how is one to make sense of this division in book 15? One great hindrance in interpreting it as a division into coordinate parts is, I surmise, a modern confusion about “mathematics” and when, if ever, it is a term that renders «μαθηματική».

Mathematics and μαθηματική

Mathematics, at least premodern mathematics, is a science of quantity, both numerical and spatial. In ancient Greece, mathematics would be arithmetic, geometry (planar and solid), and trigonometry. Plainly, what the Greeks called μαθηματική is not in the first instance mathematics because, in addition to arithmetic and the rest, μαθηματική includes optics, harmonic science,

10 As Mayhew has pointed out to me, later copyists may have been moved to assign 1.30–57 to a separate book because they saw these two groups of *problemata* as constituting coordinate parts, on the grounds that 1.1–29 concern the causes of disease for the most part and 1.30–57 address the treatment of diseases and other ailments. Moreover, he notes, this may be what brought Ḥunain ibn Ishāq (ninth century AD) to assign each of these two parts to its own book (his books 1 and 2) in his Arabic translation (see Filius 1999, 58–61). See Filius (1999, xi, xxx–xxxv, xxvi–xxix) for argument that Ḥunain (not Thābit ibn Qurra) is the translator and that this translation was made directly from a Greek version. (See Filius 1999, xxviii on Ḥunain's mode of translation.)

One may well ask whether this division was to be found in Ḥunain's exemplar or whether it is his own contribution, given especially the numerous departures in his version from any surviving Greek manuscripts. According to Flashar (1991, 385), there are Greek manuscripts in which book 1 is divided into two books in this way. But the problem here is that these manuscripts are later and that Ḥunain's Greek exemplar is no longer extant. Moreover, while Filius uses the modern edition of the Greek text advantageously to show how Ḥunain has adapted his diction and syntax in light of the Greek version, and while there are clear signs that both Ḥunain's translation and Y^a (and, hence, all modern editions) derive from Greek manuscripts that included post-Galenic elements (see Filius 1999, xvii–xxvi), we are hardly in a position to credit some difference between the modern Greek text and Ḥunain's translation to Ḥunain's Greek exemplar.

So far as book 15 is concerned, which Ḥunain breaks into two, his books 16 and 17, it seems likely at this juncture that the substantial departure from Y^a of Ḥunain's version of *problema* 3 as well as the introduction of a version of *problema* 4 not found in Y^a (see Filius 1999, 644–55) are due to Ḥunain alone.

and astronomy, sciences which, though quantitative, are not *of* quantity. Countering that optics, harmonic science, and so on are mathematics because they *apply* mathematics will not do either, since this proposal wrongly confuses what is known in these sciences with how it is known. That is, while it is certainly recognized in antiquity that astronomy uses mathematics, no ancient would claim that this science *is* mathematics: for them (as for us), the subject of astronomy is not quantity but the celestial bodies and their motions. In short, the notion of applied mathematics, like that of applied science, is foreign to the ancient Greeks and belongs to more recent efforts to map knowledge and the intellectual world.¹¹

Yet, if «μαθηματική» and its cognates do not mean «ἀριθμητική» or «γεωμετρία» and theirs in Y^a, at some point in the history of the text, there was a scribe who was plainly concerned to make clear why there were two parts in this book, each with its own title.¹² And this, I surmise, required showing the reader how to understand «ὅσα μαθηματικά».

The Interpretative Challenge

Now, it is common enough in ancient Greek to use «μαθηματική» and «ὁ μαθηματικός» to designate respectively astronomy and the astronomer. Aristotle, for example, does this in contexts when «ἄστρολογία» and «ὁ ἄστρολόγος» do not suit the point at hand, typically, that astronomy is a mathematical science and that its practitioners use mathematics to develop their arguments about the heavens, arguments which explain why things are as they are and do not just account for the fact that they are so.¹³ Again, in another context, Hipparchus develops his commentary on the *Phaenomena* of Eudoxus and of Aratus by casting ἄστρολόγοι (notably, Aratus) and μαθηματικοί (notably, Eudoxus and himself) as rivals in their claims to expertise in astronomy. (Needless to say, poets do not fare all that well in this competition.)

As I see it, then, some scribe of book 15 understood that «μαθηματικά» meant “astronomical” or, better, “in mathematical astronomy” given the nature of

¹¹ On “applied science”, see Bud (2012).

¹² Whether the list of titles between books 14 and 15 is an intervention of the copyist of Y^a or of an earlier scribe is impossible to tell, given the manuscripts that we now have. At the least, we can observe that it is not to be found in Hunain's translation (see Filiius 1999, 644–45). Accordingly, I will speak of it only as a contribution by some scribe rather than as one by the copyist of Y^a, thus leaving the question open.

¹³ See, e.g., Aristotle, *APo.* 1.13.78b32–79a5; *Cael.* 2.11.291b6–10, 2.14.297a2–5; *Metaph.* Λ.8.1073b3–8. Cf. Bowen 2013, 203–204.

Pr. 15.1–4 themselves. But, having come this far, he found himself obliged to indicate why the title «ὅσα μαθηματικά» was not duplicated by «ὅσα περὶ οὐράνια».

The Scribe's Solution

The solution was to insert between books 14 and 15 text brief enough to convey that it was a listing of titles while still clarifying what the coordinate titles in book 15 mean.

In this listing, it is important to see that «καὶ ὅσα περὶ οὐράνια» is not meant as the title of a separate book. It is instead, as the retention of «καὶ» would suggest, a title coordinate with «ὅσα μαθηματικῆς μετέχει θεωρίας ἀπλῶς». In other words, the first two entries designate the coordinate parts of book 15. Indeed, the second in this listing is the same as that found in f. 90r and which may have been modified in f. 1r for extraneous reasons.

This means, then, that «ὅσα μαθηματικῆς μετέχει θεωρίας ἀπλῶς» is meant to explain «ὅσα μαθηματικά». This makes «ἀπλῶς» (“without qualification” or “in general”) the key term. In effect, the scribe's point would seem to be that his first three (our first four) *problemata* share in mathematical astronomy without qualification, that is, they broach it in general. This means, I take it, that they are foundational or propaedeutic to “any” investigation in this science and should thus be distinguished from the next *problemata* that concern certain celestial bodies.

Accordingly, I translate and present the text inserted between books 14 and 15 in Parisinus gr. 2036 f. 89r as follows:

These [titles] are included:

- All the [*Problemata*] that share in Astronomical Theory in General
- and All the [*Problemata*] that concern the Celestial Bodies
- All the [*Problemata*] that concern Things Lacking Soul
- All the [*Problemata*] that concern Things Ensouled
- All the [*Problemata*] in Mathematical Astronomy

where this last line is the title of the first part of book 15.

3 Prospectus

But if this is right, we have just arrived at the very beginning of a new reading of book 15 and perhaps of the *Problemata* itself. The challenge now is to understand:

- how *Pr.* 15.1–4 raise issues that are foundational to the study of the heavens that uses mathematics to advance its arguments, and
- how 15.5–13 actually bear on, or contribute to, such a study.

That is, the task still before us is to assess the scribe's interpretative agenda by determining whether there is a reading of the *problemata* in this book that can make sense of his distinction between these two groups and warrant their inclusion in a single book. This is a daunting task, to be sure, and one that I take up in a work currently in progress, *Prolegomena to a Study of the Heavens: Problemata 15 in Parisinus graecus 2036*.¹⁴

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¹⁴ I am grateful to Robert Mayhew and thank him warmly for inviting me to contribute to this volume. I also thank Fabio Acerbi for his invaluable guidance in reading Parisinus graecus 2036.

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Musical Pitch and the Enigmatic Octave in *Problemata* 19

Andrew Barker

Greek philosophers and musical theorists were fascinated by the phenomenon of the octave. They treated it as a paradigm of completeness, its bounding notes as instantiating a perfect reconciliation of opposites, and the internal structure it exhibited in a regular scale as a prime example of the coherent organization of the parts of a whole. It is the finest of all the concords, the supreme instance of *συμφωνία*, whose two constituent notes blend into a seamless unity in which neither element is individually detectable. In musical scales it begins and ends a full cycle of notes, so that the highest and the lowest seem somehow identical, and any further continuation of the scale merely repeats the same pattern of relations as appeared in the first octave. Experiments with instruments, together with speculations in physical acoustics, led Pythagorean theorists and other exponents of the mathematical form of harmonic theory to assign it, correctly, the ratio 2:1; and this ratio is the product of the next two ratios in order, 3:2 and 4:3, which correspond to the two other principal concords, the perfect fifth and the perfect fourth. The constituent terms of these ratios, 1, 2, 3, and 4, add up to the perfect number 10, forming the Pythagorean “*tetraktys* of the decad.” Ptolemy, following unspecified Pythagorean sources, calls 2:1 the “best” ratio, since it is the one in which the smaller term is the largest simple fraction of the greater; and this in turn prompted attempts to explain its other remarkable properties by mathematical methods.¹

Comparable ideas about the octave and enquiries arising from them are lavishly represented in Book 19 of the *Problemata*. Nearly half of its fifty sections either explicitly raise questions about the octave or include comments about it

1 Ptol. *Harm.* 1.5, 11.1–12.7 Düring; cf. also especially 1.7, with Barker (2000), 54–87. When reporting “Pythagorean” theories in his sophisticated essay in mathematical harmonics, Ptolemy drew heavily on works written between the third century BCE and his own time, especially, perhaps (as his commentator Porphyry asserts), on that of a certain Didymus (probably first century CE). Except in a few cases in which the original source (that of Didymus or of Ptolemy himself) was a work by Archytas, we cannot be confident that the theories reported go back to the Pythagoreans of the pre-Platonic period.

in their answers to other questions; and in a number of others, especially those concerned with relations between higher and lower pitches in general, the main example that the writers had in mind appears to be the relation between notes an octave apart. Some of their remarks seem obtuse, and perhaps some are; but often more careful examination can uncover thoughts that are both coherent and perceptive. Their questions and statements draw—sometimes in unusual ways—on a wide range of ideas about the octave, and about the special affinities between notes an octave apart. More generally, they sketch some intriguing ideas about the nature and the physical basis of differences of pitch, and I shall make these the focus of the first section of this paper. I shall also comment on the fact that the theories at work in *Pr.* 19 contrast rather sharply and surprisingly with those used in similar contexts in *Pr.* 11.

The second part of the paper investigates the concept conveyed by the adjective ἀντίφωνος. It plays a central role in *Pr.* 19's discussions of the octave but is rarely mentioned by other Greek musical theorists; and with just one exception, those who do introduce it offer it no clear-cut definition. Its prominence in *Pr.* 19 is therefore remarkable in itself, and the passages where it occurs in this text give us the best chance we have of fathoming its elusive meaning. Even if I fail to disentangle all the difficulties (as I surely will), we shall pass through some fascinating theoretical scenery along the way. To complete this introductory flourish I should perhaps add my opinion, for what it is worth, that everything in this book of the *Problemata* could have been written, and probably was, within fifty years or so of Aristotle's death; and in due course I shall offer a suggestion that would pin at least some of its contents to a more closely circumscribed span of years in the early third century BCE. In that connection I shall again comment briefly on the relations between Books 19 and 11.

1 The Octave and Conceptions of Pitch-Difference

We say that one note is “higher” than another and that the other is “lower,” but these expressions are obviously metaphorical. They do not give direct, “literal” descriptions even of the phenomena we perceive, let alone of the physical events that underlie them. Greek writers rarely use these metaphors, but the terms which both specialists and non-specialists most commonly put in their places, ὀξύς, “sharp,” where we say “high,” and βαρύς, “heavy,” where we say “low,” are equally metaphorical, as Aristotle (*DA* 2.8.420a26–b4) and many others point out; and so are all the other words they sometimes use instead, for instance a family of expressions connected with the notion of tension. It would appear that no one looking for an intellectually respectable explanation

of the relation between two pitches an octave or any other distance apart (which is itself a metaphor) can expect to extract it from the implications of the language in which it is normally described; and we would expect Greek theorists to draw instead on the more objective concepts and terminology of the physicists.

So indeed they often do, and in general *Pr.* 19 is no exception. But at least one of its explanations seems to be based on features of linguistic usage. In 19.8 we read: “Why does the low note contain² the sound of the high note? Is it because the low note is greater? It is like the obtuse (ἀμβλύς) angle, whereas the latter is like an acute (ὀξύς) angle.”³ This remark evidently trades on the regular meaning of ὀξύς in non-musical contexts, “sharp,” and its association of a low note with an obtuse angle may merely reflect the prior suggestion that a lower note is “bigger” than a higher one. But though this diagnosis is surely correct, we would be doing the writer an injustice if we left it at that. Despite its apparent naivety the explanation has a distinguished ancestor and an almost equally distinguished companion.

The ancestor is Aristotle in the passage mentioned above, reflecting on the reason why high pitches are called “sharp” and low ones “heavy”:

These things are said on the basis of a transference from tangible things, for the sharp [in tangible things] moves the sense a great deal in a short time, while the heavy moves it to a small extent in a long time. It is not the case that the sharp [sound] is swift and the heavy slow; rather, the movement of the former acquires its quality *because* of its speed and that of the latter *because* of its slowness. There seems to be an analogy with the sharp and the blunt (ἀμβλύς) in the domain of touch; for the sharp pierces, as it were, while the blunt pushes, since the former produces movement in a short time and the latter in a long one, with the consequence that the one is swift and the other slow.

I suggest that the writer of 8 based his proposal on this passage, relying on it for the idea that the adjectives “sharp” and “heavy” are not used arbitrarily in

2 Here and in *Pr.* 19.7, “contain” (ἵσχει) is an emendation for “dominate” or “prevail over” (ἱσχύει). The MSS reading is in both cases defensible; but cf. 12, where the notion of containment (differently expressed) is unquestionably in play. In explaining the phenomenon it addresses it asks: “Is it because the low is large, so that it is strong, and the small is present in (ἔνεσται ἐν) the large?”

3 Translations of passages in *Problemata* are adapted from Mayhew (2011); translations of other writings are my own.

acoustic contexts. They are applied to sounds for the cogent reason that the movements which physically constitute or underlie such sounds act on our senses in ways precisely parallel to those of sharp and blunt (“obtuse”) solid objects.⁴ His statement does not simple-mindedly rely on the superficial impressions given by ordinary language, but implicitly invokes ideas proper to the sciences (a combination of physics, physiology, and psychology).

The “companion” I mentioned is Theophrastus. In the course of a long and complex passage⁵ he deploys the notion that high and low sounds are respectively “acute” and “obtuse” in a different way from Aristotle, but again by reference to what actually happens and not to what linguistic conventions suggest. He argues that if high-pitched sounds travel further than low ones, as seems to be the case, this is not because they are quantitatively greater (for instance by being more vigorous), but “because of their shape,” in the sense that a high note projects itself mostly in a single, clearly focused direction, whereas a low note travels “more equally all about.” He does not describe their trajectories as acute-angled or obtuse, but the affinity between his position and the Problem-writer’s statement is evident. And although the Greek language might encourage Theophrastus’ assertions he makes no allusion to it; the evidence he offers in their support is drawn exclusively from empirical observation.

At first sight 8 looks utterly trivial and unpersuasive, more so, perhaps, than any of the others we shall consider. I have tried to show that it may not be as silly as it might seem. But on the face of it the question it sets out to answer is even more puzzling than the response. In what sense is the high note “contained” in the low? Is the writer describing an audible phenomenon, or extracting an implication from a proposition in acoustic theory, or telling us something about musical practice or the capacities of instruments, or inferring the notion from a feature of linguistic usage? What is the basis of his supposition? It is hard to be sure, but the same thesis appears in 7 and 12, and these offer our best clues to its meaning.

In 7 the writer is trying to explain why, when attunements were formed on lyres with only seven strings (and hence it was impossible to assign one string to each note of an eight-note octave), the musicians retained the octave’s lowest note, *hypatê*, and omitted its highest, *nêtê*. After considering the possibility that this description of their practice is mistaken, he continues: “or is it not [false], but it is the case because the lower note contains the sound of the

4 Aristotle does not try to explain why low-pitched sounds are called “heavy” rather than “blunt”; he seems to assume that there is an obvious connection between the two attributes.

5 Fr. 716 FHS&G (= Porphy. in *Harm.* 61.16–65.15 Düring). The passage relevant here is at lines 87–100.

higher note, so that *hypatê* yields the *antiphônon*⁶ better than *nêté*. . . .” In 12, the question to be answered is why (at moments when the notes of the melody and its accompaniment are different) the melody’s note is always the lower of the two (cf. also 49).⁷ The writer asks: “Is it because the low is large, so that it is strong, and the small is present in the large? Indeed, in division there are two *nêtai* in the *hypatê*.”

These two passages are to be construed in closely related, perhaps identical ways. In some writings, as Mayhew says in his note (2011, 541 n. 29), “division” (διᾱλῆσις) refers to the procedure of “stopping” a string part way along its length. From the late fourth century onwards theorists used this technique to demonstrate the ratios of musical intervals on the instrument known as the *kanôn* or monochord, dividing the string into differently related lengths by means of a movable bridge.⁸ Other things being equal, the note produced from half the length of a string will sound at exactly an octave above the note from the whole string, and in this sense two instances of the higher note, *nêté*, are present within the lower note (or string), *hypatê*. But διᾱλῆσις in the sense “division” is not a technical term in Greek musicology, nor is it invariably connected with the use of the monochord. It is more likely, I think, that the writer’s remark is based on a related aspect of performance on familiar musical instruments of the lyre type, since both 12 and 7 are concerned with questions about musical practice, not the activities of theorists. No instrument in regular use was equipped with a finger-board or frets against which the strings could be firmly stopped, as on a violin or a guitar.⁹ But if a lyre’s string is lightly touched at the halfway point by a finger-tip of the player’s left hand and struck with the plectrum held in his right, it can produce the harmonic an octave above the string’s normal pitch. In this way the player can persuade the string to reveal the higher note that it “contains,” and since it can be extracted from either of the two parts into which the string has been divided, the string or note in the lower octave “contains” two instances of its counterpart in the higher. Hence the problem facing musicians using seven-stringed lyres, as the writer of

6 On the adjective *antiphônos* see Section 2 below. The essential point here is that it refers to the note an octave away from the one actually played.

7 On this statement and issues to do with accompaniment practices more generally see Barker (1995).

8 On the monochord and its history see Creese (2010). He discusses the date of its introduction on pp. 97–130.

9 It could be done on the small, lute-like instrument called the *pandoura*, but this was a foreign import with no public profile, known only from a few allusions in the literature and a number of representations in art, especially in the hands of women in terracotta figurines. See e.g. Maas and Snyder (1989, 185–86) and West (1992, 79–80).

7 conceives it, is soluble if they retain the string for the octave's lowest note and assign no string to the highest; whereas omission of the former and the inclusion of a string for the latter would give them no access to the lowest.

In that case the "fact" on which 7 and 12 rely for their explanations, and which 8 in its turn attempts to explain, is grounded in observation of the practices of performing musicians, and is independent of the work of theorists. In 8 and 12 it is associated with the contention that the lower note is "greater." But that seems to be no more than another way of saying the same thing; and hence when the notion of the lower note's greater size reappears in 13 and perhaps in 11 it is likely to reflect the same pattern of thought. Other passages concerned with relations between high and low pitches in *Pr.* 19, however, to which we shall now turn, are much more closely related to theoretical or scientific hypotheses. All of them presuppose or explicitly invoke the practice of treating musical intervals as ratios of numbers, which was pioneered by early Pythagoreans, adopted by Plato and frequently exploited by Aristotle, and which assigned to the basic concords (*sympphônai*) the ratios to which I referred at the beginning of this paper.

What, then, are the variables to which the terms of these ratios refer? Clearly they can be related to relevant dimensions of instruments, such as the sounding-lengths of strings or pipes, as experiments (or at any rate experience) had shown; and when 23 offers an explanation of the fact that notes an octave apart are in the ratio 2:1, it does so by appealing to these observations alone. But the notes are not identical with the dimensions of the items that produce them, and one cannot transfer the ratios from the instruments' dimensions to the notes themselves without further argumentation. Further, the notes' pitches themselves cannot *be* the variables related to one another in these ratios, not, at least, in the guise in which we perceive them; the ratio of the octave is 2:1, but it makes no sense to say that the perceived pitch of a higher note is twice (or half) that of a lower. Significant attempts to identify the relevant variables focused instead on the underlying physical factors whose quantitative variations are causally responsible for our impressions of higher and lower pitches. That is, the problem was treated, correctly, as an issue in the infant science of physical acoustics.

Our knowledge of Greek ideas in acoustic theory before the fourth century is scanty, especially in connection with the determinants of pitch. But from the time of Archytas and Plato onwards we have a good deal more information, and it is the theory of Archytas, modified by Plato and again by Aristotle,¹⁰

10 Archytas fr. 1, Plato *Tim.* 67b, Aristotle *DA* 2.8.420a26–b4.

that was adopted by the great majority of writers through the rest of antiquity.¹¹ It postulates that a sound is physically constituted (or in Aristotle's version, caused) by a special kind of movement in or of the air or some other suitable medium;¹² and that when this movement travels through the medium more swiftly the sound's pitch is higher, and when it travels more slowly the pitch is lower. The ratios can then be interpreted as those holding between the speeds of the relevant movements. A few later writers offer variants on this theme, but most are content merely to presuppose it, or to set out its contentions in greater or lesser detail.¹³ It appears to form the theoretical background to four passages in *Pr.* 19 (21, 35b, 37, and 50) and unusual conclusions are drawn from it in 21 and 35b. But since the theory to which these passages subscribe is familiar and their reasoning is tolerably clear, I shall not discuss them in this paper.

There was, however, a second theory. Its details are explicitly set out in only one source of this period, the introduction to the *Sectio canonis* insecurely attributed to Euclid and written (or so I have argued) at a date not far from his.¹⁴ Important aspects of it appear also in two other texts, the pseudo-Aristotelian *De audibilibus* most probably written by Strato in the first half of the third century, and a passage quoted by Porphyry from a certain Heraclides, who may or may not be the fourth-century Platonist Heraclides of Pontus.¹⁵ According to the thesis of the *Sectio canonis*, every sustained sound is caused by a sequence of separate impacts on the air, producing successive movements in it which impinge separately on the ear. Because they follow one another very rapidly, we do not detect the gaps between the impacts, and they create the impression of a single, continuous sound (this aspect is best brought out in the passage of

11 A passage in Theon of Smyrna (59.8–10 Hiller = DK 18.13) records a report which seems to suggest that the theory was pioneered by Lasus and Hippasus (or “those in the circle of Hippasus”), early in the fifth century. The report's reliability is debatable, but the arguments used to dismiss it by Huffman (2005, 472–73) do not strike me as compelling.

12 Plato's account has its own peculiarities, but they need not concern us.

13 Porphyry quotes a passage from a work on the *Timaeus* by a certain Aelianus, which displays a sort of elephantine meticulousness in its remorseless exploration of the minutiae. See Porph. in *Harm.* 33.16–37.5 Düring, especially 36.9–37.5.

14 *Sect. can.* 148.3–149.8 Jan. For discussions of problems connected with its date see particularly Barbera (1991, especially 3–36) and Barker (2007, 364–410).

15 [Arist.] *Aud.* 803b34–804a8, Porph. in *Harm.* 30.1–31.21 Düring. For the attribution of the former to Strato see Gottschalk (1968). For arguments against identifying Porphyry's Heraclides with Heraclides of Pontus see Gottschalk (1980, 157). His arguments have been accepted by most scholars, but (as I have said briefly in various publications) I do not think that they are conclusive and I am inclined to adopt the contrary view. I hope to publish a fuller discussion in the near future.

Heraclides). The perceived pitch of the sound depends on the rate at which the impacts succeed one another: a closer succession of impacts yields a higher pitch; if they are more widely spaced the pitch is lower.¹⁶ According to this hypothesis, if one note is constituted by twice as many impacts in a given time as another, the first will be an octave above the second.

Most of our evidence about fourth-century theories of pitch comes either from Plato and Aristotle, or from Platonist sources in later antiquity, and I suspect that the non-Platonist theory I have outlined played a greater part in the acoustic speculations of this period than those writings reveal. Long ago, in an enormous footnote, I suggested that it underlies a curious procedure attributed by Archytas to some of his Pythagorean predecessors, through which they attempted to place the concords in order of excellence.¹⁷ If this hypothesis is correct, the theory must go back to Pythagoreans of the very early fourth century or possibly even the fifth. Given its relative rarity among the ancient testimonies on acoustics, it is remarkable that two passages of *Pr.* 19 (39b and 42) not only exploit it but apparently assume that it is well known and authoritative. There are possible traces of it in other passages too, but they are too slight to support any definite conclusion.

Pr. 19.39b asks why people “magadize” in the concord of the octave, apparently meaning “in the concord of the octave but no other.”¹⁸ Here is its initial suggestion:

16 The theory was probably based on observations of the behaviour of strings, longer and shorter or more loosely and more tightly stretched, whose back-and-forth oscillations were conceived as beating on the air with each backward or forward swing. See e.g. Porph. in *Harm.* 35.1–7 Düring. It rarely appears explicitly in sources other than those I have mentioned. The main exception is Boethius, who draws on the theory in several passages (see especially *Inst. mus.* 1.3, 1.31, 4.1). We can infer that it had been adopted, or at least discussed in detail, by Nicomachus, in the longer treatise on harmonics which he promises at the beginning of his short surviving essay (*Harm.* 1), but which is now lost. Most of Boethius’ work is apparently based on this lost treatise (see e.g. Bower 1989, xxiv–xxviii), and Boethius says explicitly that the theory outlined in 1.31 is that of Nicomachus. But it is clear from 1.3 and 4.1 that the main—and probably the only—sources on which the latter had drawn were the *Sectio canonis* and (to a smaller extent) Heraclides.

17 Barker (1989, 35 n. 29); the passage is Porph. in *Harm.* 107.15–108.21 Düring = DK 47 A17.

18 The verb *magadizein* refers to the practice of performing a melody at two different pitches simultaneously, either on an instrument or instruments or with higher and lower voices. In principle the word could have applied to the performance of a pair of melodic lines running parallel to one another at the interval of e.g. a fifth; but in fact the allusion is always to singing or playing in octaves, since as 39b implies, the octave was the only interval that Greek musicians used for this purpose. We shall revisit the topic in Section 2 below.

Is it because just as in metres the feet, in relation to themselves, have a ratio of equal to equal or two to one or indeed some other, so too the notes in a concord have a ratio of movement in relation to themselves?¹⁹

By itself this does not tell us much, unless the comparison of the notes in a concord with the elements of metre, that is, the syllables of words, is already a hint that the writer is thinking of both of them as sequences of items strung out in time. But the passage continues as follows:

In the case of the other concords the termination of one note or the other is incomplete, ending halfway: this is why they are not equal in power. And since they are unequal, there is a difference in how they are perceived, as there is in choruses when some sing louder than others as they are ending. And further, it is a fact that *hypatê* has the same ending [as *nêtê*]²⁰ in the periodic [movements] of the notes; for the second impact of *nêtê* on the air is *hypatê*.

Some of this is rather enigmatic, but one thing at least about the last clause is clear, and it indicates unambiguously the theoretical framework within which we should try to interpret the rest. If a note is conceived as involving several impacts on the air, the framework must be provided by the “multiple impacts” hypothesis that I have sketched, and the statement can be interpreted as shown in Figure 1 below.

<i>Nêtê</i>	I n n n n n n n . . .
<i>Hypatê</i>	I h h h h . . .

FIGURE 1

19 The awkward phrase “in relation to themselves,” which appears here twice, is a literal translation of the Greek πρὸς αὐτοὺς. When it is applied to the feet, I take it to refer to the fact that the ratios are those of the parts of each foot to one another, the arsis and thesis or *anô* and *katô* of Classical rhythmic theory, and not (as Mayhew’s translation suggests) those between the lengths of different feet. When it is applied to the notes of a concord, I assume that the writer is treating a concord, like a foot, as a single item composed of two distinct elements, and that the ratio is again the one that holds between its parts.

20 *Nêtê* and *hypatê* are notes, the first of which is an octave above the second. The words “as *nêtê*” are bracketed because they do not appear in any of the surviving MSS (though they do appear in Theodore Gaza’s Latin translation). In any case the sense conveyed by their inclusion is evidently the one that the author intended, whether or not he made it explicit.

Here time runs from left to right. Each instance of the symbol *n* represents one of the impacts on the air that are constitutive of *nêtê*, and each *h*, correspondingly, is an impact of *hypatê*. For each note the symbol *I* represents the musician's act of striking or plucking the relevant string (it is assumed that the two strings are struck simultaneously). We should notice that according to the model in Fig. 1 no "constitutive impact" occurs at the moment of striking; *first* the musician's action sets the string in motion, and *then*, at some slightly later moment, it strikes the air for the first time. In that case the "second impact of *nêtê*" mentioned in our passage is the second instance of *n*, and it coincides with the first impact of *hypatê*. Thus what this pair of impacts presents to our ears is simultaneously both the higher and the lower note of the octave, and this seems to give an intelligible sense to the writer's statement that "the second impact of *nêtê* . . . is *hypatê*" (though it remains a rather odd way of putting the point).

At first sight there seems to be a difficulty. The writer denies that what he says of the octave is true of the other concords: in their case "the termination of one note or the other is incomplete, ending halfway." Now if we transfer the model used in Fig. 1 from the octave to—for instance—the concord of a fifth, whose ratio is 3:2, exemplified in the relation between the notes *paramesê* and *hypatê* (where *hypatê* is the lower of the two), we get the following result:

<i>Paramesê</i>	I p p p p p p p p . . .
<i>Hypatê</i>	I h h h h h h . . .

FIGURE 2

Here again some impacts of the higher note coincide with impacts of the lower and some do not; but whereas in the first example (Fig. 1) the second impact of *nêtê* coincides with an impact of *hypatê*, in the second (Fig. 2) this is not true of the second impact of *paramesê*. At the relevant instant the *hypatê* string is only halfway through its journey towards its own second impact, and this seems to correspond plausibly to what the writer asserts. But why is it appropriate to focus in particular on the *second* impact of *paramesê* and not some other? *Nêtê* has two impacts in the time in which *hypatê* has one, a fact that gives the second impact of *nêtê* some significance when we are considering the relation between these notes. Then since we specify the relation between *paramesê* and *hypatê* by saying that the former has three impacts for every two of the latter, why is it not the *third* impact of *paramesê* that should claim our attention? If we make that our point of reference, however, we shall find that

it marks a moment when impacts of the two notes coincide; as we are told at [Arist.] *Aud.* 804a2–6: “in all concords the impacts of the higher notes on the air occur more frequently . . . but the last of the sounds strikes our hearing simultaneously with the sound from the slower movement.” The writer of 39b is alluding to a moment when one of them is “incomplete,” and here that does not seem to be the case.

A focus on the third impact of *paramesê* will therefore fail to capture the situation the writer is trying to convey; and one detail of the text hints at a reason why it is its second impact that should concern us. The clue is in the writer’s allusion, at 921a22–23, to the “periodic [movements]” (*periodoi*) of the notes. Here I have retained Mayhew’s translation, but perhaps the word “cycles” would catch the sense more lucidly; a *periodos* is a cycle of movement which has completed its course and returned to its origin, so that if it continued further in the same manner it would be merely repeating the same journey as before. According to the theory we are considering, the movement of a plucked string has two phases, a movement forward (*antistasis*) from its original position and a recoil (*apokatastasis*),²¹ in each of which it makes an impact on the air; and the two phases together form a *periodos*, a full cycle. Thus a note may be thought of as fully instantiated as soon as one such cycle has been completed; and from this perspective it seems entirely appropriate to focus in every case on the moment at which the *second* impact of one note or the other occurs (that is, the impact caused by the *apokatastasis*), regardless of the ratio between them. This interpretation fits well into the context of the statement in which the reference to “cycles” appears: “it is a fact that *hypatê* has the same ending [as *nêtê*] in the *periodoi* of the notes.” This can now be taken to mean that every *apokatastasis* of *hypatê* coincides with an *apokatastasis* of *nêtê*, and a glance at Fig. 1 above will show that this is true; while a glance at Fig. 2 will show that the whereas the *apokatastasis* in every second cycle of *hypatê* coincides with an *apokatastasis* of *paramesê*, there are no such coincidences in the intervening cycles.

Of course I cannot insist on all these details. There are other ways of modeling the patterns of impacts (though none that I have thought of fits the text as smoothly), and we must also take into account the possibility that the writer had not worked out all the relevant minutiae.²² What seems certain is that

21 See Porphy. in *Harm.* 35.1–7 Düring with n. 16 above; for the terms see 35.4.

22 Compare the case of Plato’s discussion (*Tim.* 80a–b) of the relations between the movements of the two notes in a concord, for which I can find no consistent mathematical interpretation. (I once mentioned this in conversation with Geoffrey Lloyd, who assured me that no such interpretation is possible.)

the passage's arguments, its treatment of the ratios and certain features of its phrasing can be accounted for only in the light of the "multiple impacts" hypothesis. The same is true of 42, which is concerned with sympathetic vibration; "Why," it asks, "if one plucks *nêtê* and then damps it, does *hypatê* alone seem to resound?" We shall consider its answer to the question in Section 2 below; but when the writer asserts that "the sound of *nêtê* is alien to the others both when it is ceasing and when it is beginning, whereas it is the same as *hypatê* when it is ceasing" (921b30–31), and alludes to "the second element"²³ of *nêtê* in a context that identifies this with *hypatê* (921b37), we are plainly back in the same theoretical territory as in 39b.

If I am right about the date of the introduction to the *Sectio canonis* and the identity of the Heraclides whom Porphyry quotes, and if Gottschalk was right in attributing the *De audibilibus* to Strato (see nn. 14–15 above), the only period from which we have clear evidence that the "multiple impacts" hypothesis was well known and unhesitatingly deployed by theorists is the first half of the third century BCE. (We can discount the treatments of it which reached Boethius through Nicomachus, since these, as I said in n. 16 above, are patently direct, quasi-antiquarian borrowings from Heraclides and the *Sectio canonis*.) It seems overwhelmingly likely, then, that the two passages in *Pr.* 19 that presuppose it belong to the same period. While this by itself has no implications for the dating of other passages in this Book, I can see nothing in them that would be out of place in early third-century writings. A more positive indication can be found in the fact that while questions about pitch are at issue in over twenty sections of *Pr.* 19, at most four of these passages rely on the Platonist/Aristotelian theory associating pitch with speed of transmission; elsewhere we find a motley assortment of suggestions to do with the shapes, sizes, and strengths of notes, the dimensions of instruments, the mathematics of ratios and so on, in addition to the "multiple impacts" hypothesis. It looks as though the collection was put together at a time before any general consensus about the determinants of pitch had been reached, and this too would be consistent with a date in the third century.²⁴ By the latter part of the Hellenistic

23 The Greek is τὸ δευτερεῖον, "the second [something]" where the "something" is not specified. Mayhew offers "its secondary [sound]," which from one point of view is probably correct; but I am confident, given the context, that what the writer had primarily in mind, as in 39b, was the second phase in the movement of a string, the *apokatastasis*.

24 Associations between pitch and the shape, size and greater or lesser "numerousness" of a sound, as well as its speed of transmission, appear also in Thphr. fr. 716 FHS&G. The theory that Theophrastus himself champions in that passage (that pitch is essentially a qualitative and not a quantitative variable) is different again.

period, the “speed of transmission” theory had ousted all its rivals and was in effect the only show in town.

The situation is very different in *Pr.* 11, which is commonly treated as a companion-piece to *Pr.* 19. Issues to do with pitch are involved in 23 of its 62 or 63 sections,²⁵ and 21 of them appeal explicitly to the “speed” hypothesis.²⁶ Of the two which do not, one (11.50) is very brief and offers the merest sketch of an explanation; but arguably it becomes most easily intelligible if we assume that it too presupposes the same theory. At first sight the other (24) gives no indication that its author accepted any particular theory about the physics of pitch-production. It asks why calves utter lower-pitched sounds than adult bulls, whereas in other species the voices of young animals are higher than those of the adults; and it answers the question merely by saying that the sounds made by young animals are similar to those of the females of the same species, and that in the case of cattle, unlike all other species, the voices of the females are lower than those of the males. In principle the writer might consistently have adopted any hypothesis whatever about the physics of pitch. But in fact the passage is evidently a summary reminiscence of Aristotle, *GA* 5.7.787a28–b19, where the same observations are tied directly to the “speed of transmission” theory. The writer of 24 was probably just as solidly committed to it as are all the others whose remarks about pitch are collected in *Pr.* 11.

In the light of the points I made above, this sharp distinction between the relevant passages in the two Books gives a strong indication that at least a third of the sections in *Pr.* 11 were written at a considerably later date than their counterparts in *Pr.* 19. The other general feature in which the passages of the two Books most obviously differ tells us nothing about their relative dates, but may point to a difference between their writers’ interests and intellectual allegiances. Many passages in *Pr.* 19 refer, in one way or another, to the ratios that hold between the pitches of sounds separated by certain intervals, identifying those of the octave and other concords, and sometimes distinguishing them from one another and from those of non-concordant intervals. In *Pr.* 11, by contrast, there is no suggestion that pitch-differences can be expressed in this mathematical way, and none of the arguments propounded presupposes that they can. No doubt this distinction is due in part to the fact that *Pr.* 19 is concerned specifically with music (or *harmonia*, as it says in the Book’s title), and hence *inter alia* with the nature and attributes of musical intervals, whereas in

25 There are 63 sections in all if we accept Jan’s and Mayhew’s division of the 62nd into two.

26 Three of them (16, 19, and 20) also attribute greater “thickness” to the lower of two notes, but they seem to use this as an adjunct to the “speed of transmission” theory, as a way of explaining why the higher note travels more quickly.

the context of *Pr.* 11's topic, which is voice or sound (*phônê*) in general, musical issues are no longer the centre of attention. But in a compilation so densely populated with discussions of high and low pitch, we might reasonably have expected at least occasional references to the ratios, and there are none. From this perspective (and perhaps from others) it looks as if the writers of *Pr.* 11 were inheritors of a tradition stemming ultimately from Aristotle's zoological works, together with the *De anima* and *Parva naturalia* and essays such as the *De audibilibus* and the *De coloribus*, in which—even in contexts connected with acoustic issues—the ratios are rarely mentioned and mathematical concepts play a very minor part. The relevant sections of *Pr.* 19, on the other hand, seem more in tune with Aristotle in the *Posterior Analytics*, where he assigns to mathematical harmonics the task of explaining observed facts about the audible phenomena,²⁷ with quasi-Pythagorean aspects of passages in Plato's *Republic*, *Timaeus*, and *Philebus*, and with the intellectual orientation of Plato's immediate successors in the Academy, Speusippus and Xenocrates.

2 The Octave and the Adjective *Antiphônos*

If we leave *Pr.* 19 aside, the adjective *antiphônos* occurs only three times in all Greek literature before the first century BCE, once in Euripides (*Suppl.* 800) and twice in Plato (*Laws* 4.717b2, 7.812e1). It is therefore remarkable that in *Pr.* 19 it is used eleven times, in seven different sections (7, 13, 16, 17, 18, 19, 39a). (The cognate verb, *antiphônein*, which usually means “to answer,” occasionally with the negative force “to contradict,” is rather commoner; but it does not appear in *Pr.* 19.) In the Euripides passage Adrastus asks the chorus to make utterances “responding to” or perhaps “echoing” (*antiphôna*) his groans, and the idea of a response may well be embedded in the usages of *Pr.* 19. But the earliest passage in which the adjective designates a relation between musical notes is the second passage in the *Laws*. Here the Athenian specifies various forms of accompaniment of which he disapproves, including those in which the accompanist plays notes that are *symphônoi* (“concordant”) or *antiphônoi* in relation to those of the melody. Now in *Pr.* 19 and in later musicological writings, the adjective is used only with reference to the octave; but Plato is unlikely to have intended it in this sense, given that elsewhere he presents the octave in a very positive light as a paradigm of agreement and unity.²⁸ Further, the octave is almost always included among the concords, and it would be surprising to find

27 See in particular *APo.* 1.7.75a38–b17, 1.13.78b34–79a6, 2.2.90a14–23.

28 See e.g. *Rep.* 4.432a, 443d.

a distinction drawn between concords and octaves, without explanation, in a non-technical text of this sort (though the distinction does appear in this form once in *Pr.* 19, as we shall see). In any case the contrast we would expect here is between concord and discord rather than between lesser concords and the octave. More probably, I think, the word's sense at *Laws* 7.812e1 corresponds to that of 4.717b2 (although there the context is not musical), where the adjective clearly means "opposite to" (it sometimes has a similar sense in Plutarch); the Athenian condemns accompaniments using notes that differ from those of the melody, whether they are concordant with them or the opposite, i.e. discordant.

In later technical writings on music the adjective is used by only four authors before the Byzantine period (Thrasyllus, Adrastus, Porphyry, and Gaudentius²⁹), always in association with the octave. The same association is found in several passages of Philo of Alexandria and occasionally in Plutarch, and in increasing numbers of remarks about music by non-specialists from the fourth century CE onwards. It becomes common in Byzantine writings, where it looks as if the term regularly used in earlier times to designate the octave, τὸ διὰ πασῶν ("that which is through all [the strings]"), was no longer thought adequate to express the concept by itself, and was amplified into τὸ κατ' ἀντίφωνον διὰ πασῶν, "the 'antiphonal' *dia pasôn*."

The usage of several of the pre-Byzantine authors, however, makes it clear that although the octave is the only musical relation that can be described as *antiphônōs*, the adjective does not simply mean "in the octave," and that the expressions *to dia pasôn* and *to antiphônōn* are not strictly synonymous. But they rarely give any hints as to what its actual meaning might be. The non-specialists provide nothing substantial;³⁰ and of the four technical writers who use the word, neither Adrastus nor Gaudentius makes any attempt to define it. Thrasyllus offers some remarks, but they are too enigmatic to be helpful.³¹

29 See Theo Sm. 48.17–49.1 Hiller (Thrasyllus), 51.15 (Adrastus); Porph. in *Harm.* 104.10 and 160.23 Düring; Gaud. *Harm.* 347.26, 348.1–2 Jan.

30 Plut. *De amic. mult.* (*Mor.*) 96e–f compares the concordance of *antiphônōi* musical notes with that of a special kind of friendship; in the former, "a similarity somehow arises between high and low pitches," that is, between items that differ in an important respect, whereas in this type of friendship all differences are eliminated. The same notion of simultaneous similarity and difference appears in *Pr.* 19, but by itself it does not take us far. For the notion of a "similarity" (*homoiotês*) between the notes of a concord, see also Plato *Tim.* 80a–b, and Porphyry's account (in *Harm.* 108.7–21 Düring) of some early Pythagorean terminology.

31 The octave and double octave are concordant *kat' antiphônōn*, that is, "when the low pitch lying over against (*antikeimenon*) the high is in concord with it." The fifth and the fourth,

The account offered by Porphyry, on the other hand, is both substantial and intelligible, and we shall consider it shortly; it may help in the interpretation of some of the passages in *Pr.* 19, to which we shall now turn. I will divide them into three groups.

2.1 *Aesthetic Pleasure*

In 16 and 39a *to antiphônon* is associated with a feeling of pleasure. These passages tell us little about the meaning of *antiphônos*, but they offer some insight into Greek treatments of the octave in the context of musical aesthetics.³² The question considered in 16 is why *to antiphônon* is more pleasing than *to symphônon* (which must refer here to concordances other than the octave, that is, the fifth and the fourth); and in 39a it is why *to antiphônon* is more pleasing than *to homophônon*, unison. As Mayhew notes, Eichtal and Reinach thought that the statements the MSS record in response to the question in 16 are misplaced and were not in fact designed to answer it. I think they were mistaken, though the response is heavily compressed, and only becomes intelligible if we recognise that it uses the word *symphônos* and its cognates in two quite different ways. Here is the whole passage.

Why is *to antiphônon* more pleasing than *to symphônon*? Is it because *to symphônein* is more obvious than when one sings *pros tēn symphônian*? For one [note] or the other must be in unison (*homophônein*), so that when two [notes] accompany one voice they obscure the other [note].

As I have said, *to symphônon* in the question must refer to concords other than the octave. Singing *pros tēn symphônian*, similarly, must be singing to an accompaniment in which the instrument plays a “chord” consisting of two notes a fifth or a fourth apart.³³ But in that case *to symphônein*, at the beginning of the sentence, cannot be restricted to these lesser concords but must refer to concordance in general; and the point is that this attribute is “more obvious” when one sings to an *antiphônos* accompaniment than it is when the accompanist uses a fifth or a fourth. The sequel seems to mean that this is

by contrast, are concordant *kata paraphônon*, meaning that “one note sounds neither at the same pitch as the other nor in discord with it, but sounds similar to it across some recognisable interval” (Th. Smyrn. 48.17–49.1).

32 For other discussions of musical pleasure in *Pr.* 19 see 1, 5, 9, 10, 38, 39b, 40, 43.

33 The writer is probably thinking of singing accompanied, as often it was, by the double pipes called *auloi*, on which the practice of playing two notes at the same time was perfectly normal.

so because one note or the other (of the accompaniment) must be in unison (with the voice),³⁴ and the combined forces of the voice and its unison partner “obscure” the other note of the accompaniment. Several other writers make the point that a pair of notes cannot be heard as a concord if one of them is so strong that it overpowers the other.³⁵ Then if these remarks are to explain why the concordance is “more obvious” when the notes of the accompaniment are an octave apart than it is in the other cases, it must be assumed that when (and only when) the note sounded by the voice and by its unison counterpart on the instrument is the *antiphônōs* of the other note of the accompaniment, it somehow reinforces the latter rather than obliterating it.

Making sense of the response in 16 as an answer to its question involves some ingenuity and a good deal of hypothetical in-filling. *Pr.* 19.39a is more straightforward:

Why is *to antiphônōn* more pleasing than unison? Is it because *to antiphônōn* is concordant at the octave? For *to antiphônōn* arises from [the combined voices of] young children and men, who are separated in pitch as *nêtê* is from *hypatê*. Now every concord is more pleasing than a simple note (we have already explained why), and of these the octave is the most pleasing; unison, by contrast, has a simple note.

The sentence about children and men is interesting for two reasons. First, it confirms that choruses of high and low voices, singing in octaves, were familiar in Greek musical practice; most choral performances of which we know involved one category or the other but not both together. Secondly, it offers this example as evidence that *to antiphônōn* is associated with the octave; it is something that “arises from” this combination of voices (ἐκ παίδων γὰρ νέων καὶ ἀνδρῶν γίνεται), and they are an octave apart. But this can only count as evidence if *to antiphônōn* is a recognisable phenomenon, one that presents itself when we hear people singing in octaves, and which is not identical with the octave but “arises from” it. We are left to wonder what exactly it is.

The main part of the answer to the initial question comes in the second half of the passage. It has been shown that *to antiphônōn* is attached to the octave; it is more pleasing than a unison because every concord is more pleasing than a single, unmixed note, and the octave is the most pleasing of the concords. The key premise here is that a concord is always more pleasing than a “simple”

34 To the best of my knowledge, all other comments on accompaniment in Greek writings are consistent with this thesis, but none of them explicitly asserts it.

35 See e.g. *Thphr.* fr. 716.68–78 FHS&G.

note, and we are told that the explanation of this has already been given. Here the reference may be partly to 16, as Mayhew suggests in his note (though not, I think, to 18 and 19, which he also mentions), but the most closely related ideas are in the final sentences of 38. The writer has explained why we enjoy rhythm, on the basis that “we naturally enjoy natural movements,” and that “orderly movement is naturally more akin to us than disorderly movement.” Rhythm is arithmetically orderly and “moves us in an orderly fashion,” and hence we enjoy it. In the closing sentences he explains why we also enjoy concords.

We enjoy concord because it is a mixture of opposites that stand in a ratio to one another. Now a ratio is [a form of] order, which we have seen to be naturally pleasing, and anything mixed is more pleasing than what is unmixed...³⁶

The writer’s contentions about our enjoyment of the “natural and orderly” movements of rhythm have affinities with passages in Plato’s *Laws* (notably 2.653c–654a, 664e–665a). But the excerpt I have quoted seems to be—at least in part—a reminiscence of Aristotle *DA* 3.2.426a27–b7. That passage is fraught with difficulties which I cannot pursue here,³⁷ but for present purposes we can put aside the obscurities in its argument and in its relations with other Aristotelian texts. However they are to be resolved, it clearly draws the conclusion that when the object of our perception is a mixture of high and low notes which stand to one another in some ratio,³⁸ the individual elements are indeed pleasant in their own right, but “nevertheless what is mixed, the concord, is more pleasing than the high or the low.” But even if the Problem-writer has taken this aspect of his thesis from the *De anima*, he cannot be drawing on that passage for his use of the concept of “order” (*taxis*) to integrate his statements about concord with what he has said about rhythm. He could, however, have adapted it from Plato:

36 There seems to be some corruption in the remainder of this sentence. The gist of it must be roughly, “...especially when the two notes that correspond to the terms of the concord’s ratio are equal in power,” but I hesitate to offer a translation. (Interpretation might perhaps become a little easier if we emended αἰσθητὸν ὄν at 921a5 to αἰσθητοῖν ὄντοιν.)

37 Thirty years ago I offered a reading of the passage which I still think has some merit; see Barker (1981).

38 Aristotle does not specify any particular ratio or class of ratios, but in the context must be thinking of those of the musical concords. For their privileged status, not restricted to the sphere of music, see *Sens.* 3.439b19–440a15, discussed in Barker (2007, 338–48).

Other creatures . . . have no perception of order (*taxis*) and disorder in movements, the names for which are rhythm and *harmonia*. But for us, to whom as we said the gods have been given as fellow-dancers, these same gods have given the capacity to perceive rhythm and *harmonia* and to enjoy them. (*Laws* 2.653e–654a)

And again, “The name for order (*taxis*) in movement is rhythm, and the order of the voice, where high and low are mixed together at once, is given the name *harmonia*” (2.664e–665a). Of course we cannot be certain, but it is tempting to conclude that *Pr.* 19.38 is an ingenious fusion of Platonic and Aristotelian materials, and if that were so it might give a valuable clue about the way in which the writers of *Pr.* 19 went to work.

2.2 “Analogy” and the “Sound of a Single Note”

We move on now to passages which may give more help in the interpretation of the adjective *antiphônōs*. Let us look first at *Pr.* 19.18.

Why is the octave concord alone used in singing? For people magadize in this concord, but in no other. Is it because it alone comes from *antiphônoi* notes, and whichever of them one sings, one produces the same result? For the one note contains in a certain way the sounds of both, so that even when just one [of the notes] in this concord is sung the concord is sung, as it is too when by singing both, or by one being sung and the other played on the aulos, they both sing as it were one note. That is why it [sc. the octave concord] alone is sung, because those that are *antiphôna* have the sound of a single note.

The second sentence explains the meaning of the initial question. Performers are said to “magadize” when they create two simultaneous and parallel melodic lines, as could be done by a pair of semichoruses, or two instruments, or a voice and an accompanying instrument, and so on.³⁹ Hence the question does not imply that whenever two performers or groups of performers sounded two different notes at the same time they were always an octave apart, which is certainly false (cf. Barker 1995), but that the octave was the only interval at which

39 The verb is cognate with the noun *magadis*, which sometimes refers to an instrument (a type of harp) on which a melody could be played in simultaneous octaves, and sometimes to the procedure of magadizing. For a long and confusing discussion see Ath. 634b–637a; for modern treatments see Comotti (1983) and Barker (1988).

they performed whole melodies at two different pitches simultaneously.⁴⁰ In effect the question is the same as that of 39b, which I discussed in Section 1, and it appears again in 17, which explicitly denies (though in rather different language) that melodies were performed in parallel fifths or fourths. It seems that the Greeks did not anticipate the “parallel organum” of the early Middle Ages.

The gist of the answer suggested in 18 is summed up in the third sentence; the octave arises from notes that are *antiphônoi*, and whichever of them one sings, the result is the same. The last sentence puts it even more lucidly: when two items⁴¹ are *antiphôna* they “have the sound of a single note.” But it is not clear whether—in this writer’s opinion—to say that two notes are *antiphônoi* actually *means* that they sound like the same note, or whether it indicates something different, of which “sounding like the same note” is a consequence. Further, although we can agree that there is a sense in which notes an octave apart sound the same, there is obviously another way in which they do not, since their pitches are different; and the writer makes no attempt to analyze or characterize the “sameness” to which he refers.

Aspects of 17 are puzzling, but it is apparently trying to pursue the issues in a little more depth:

Why do they not sing *antiphôna* at the fifth? Is it because the concordant [note] is not the same in this concord as it is in the octave? For there [sc. in the octave] the low note is analogous in the low range to the high note in the high; it is, as it were, simultaneously the same and different. But those [sc. the high and low notes] in the fifth and the fourth are not like that, and hence the sound (*phthongos*) of the *antiphônos* note does not appear in them, for it [the sound] is not the same.⁴²

40 We may guess that the same applied also to phrases within a melody, at least when they were more than two or three notes long.

41 The neuter plural *antiphôna* leaves open the question of what these items are, but clearly they must be notes.

42 Here are some comments on the respects in which my translation of this passage differs from Mayhew’s. (i) At 918b35 the noun implied by ἡ σύμφωνος (feminine) must I think be χορδή, here (as in 18) meaning “note” rather than “string”; the adjectives meaning “high” and “low” in this passage, which can only refer to notes, are also feminine. (ii) In the same line, rather than bracketing the words τῇ συμφωνίᾳ, as Mayhew does (following Eichtal and Reinach), I prefer to read <ἐν> τῇ συμφωνίᾳ with Ruelle, or perhaps better <ἐν ταυτῇ> τῇ συμφωνίᾳ. At the beginning of the next sentence we should probably read ἐκεῖνῃ (adverbial dative), meaning “there”; Mayhew translates in the same way, though his text reads ἐκεῖνῃ (nominative). In the last sentence I again take the feminines αἱ ἐν τῷ δια πέντε and τῆς ἀντιφώνου to refer to notes. The masculine φθόγγος in this sentence (which must

The sound of the *antiphônos* note does not present itself when the notes played or sung are concordant at the fifth or the fourth, because these notes are not “simultaneously the same and different”; but they are so in the octave, and this characterisation seems designed to explicate the thesis that the lower note of the octave is “analogous” (*analogon*) to the higher. The same idea appears in 14, which answers the question “Why does the octave escape notice and seem to be in unison?” by observing, first, that its notes are not really in unison, “but are analogous (*analogon*) to each other at the octave,” and then suggesting that they *appear* to be the same note “because of the analogy” (*dia to analogon*). In the case of notes, the writer adds, *to analogon* is equality, *isotês*, “and the equal is characteristic of the one.”

But what sort of equality is this, and how are we to understand the notion of “analogy” in this context? Certainly we should not be misled by the mathematical resonances of the words *isotês* and *analogon* (in mathematics *analogia* means “proportion”). It makes no sense to describe the upper and lower notes of the octave as mathematically equal, and although—as we have already seen—ratio and proportion play large parts in Greek harmonic theory, statements to the effect that the relevant notes are “in proportion” or “in a ratio” (*logos*) to one another would be altogether alien to the argumentative contexts of 14 and 17. These passages make no reference to items of the kinds to which conceptions of ratio and proportion can be intelligibly applied (the inaudible physical movements underlying sounds or the relative dimensions of sounding objects); they are entirely concerned with the audible sounds themselves. It is the *sounds* of the higher and lower notes that are “the same and different” in the case of the octave, and in the case of the minor concords it is the *sound* of the *antiphônos* note which is missing (*ouk emphainetai*, it does not present itself to our perception). It looks, then, as though the “analogy” or “equality” involved here is of a musical rather than a mathematical sort, and perhaps when the writers use quasi-mathematical language to express what they mean, it is not because the thought to be conveyed is a truth of mathematics, but simply because they lack musicological terminology adequate to their purpose. As a consequence, the conceptual profile of *to antiphônon* still remains hazy.

Clarification can be found, I suggest, in the passage of Porphyry which I mentioned earlier, in which he is commenting on Ptolemy’s statements at *Harm.* 13.1–22 Düring. It runs as follows.

be the subject of the concluding clause) should also in most cases be translated “note”; here I translate it as “sound” merely to avoid having to refer to “the note of the note.”

What he is saying is something like this. The notes that make the concord of the octave, *hypatê mesôn* and *nêtê diezeugmenôn*, for instance, do not differ in function (*dynamis*) from just one note; for although they are opposites their function is the same, and thus the function of both is as that of one. For this is what it is for two not to differ in function from just one: it is what happens when a function is expressed by two notes as if by one. This is why the notes are also called *antiphônai*, just as someone equal to a god is called *antitheos*, and the Amazons, who are equal in strength (*dynamis*) to men although they are women, are called *antianeirai* (Porph. in *Harm.* 104.5–12 Düring).

In introducing the concept of melodic “function,” Porphyry is borrowing directly from the part of Ptolemy’s text that he is discussing, but its origin is much earlier. It first appears in the writings of Aristoxenus, who draws important distinctions between a note’s *dynamis* and its pitch, and again between its *dynamis* and the size of the interval between it and some other specified note of the system.⁴³ He contends that a note’s musical identity depends on its *dynamis* and not on either of those other factors, and that the names attached to the notes—*hypatê*, *mesê*, *nêtê*, *lichanos* and so on—do not individuate them by reference to their pitches or to the distances separating them from adjacent notes, but by reference to their melodic or scalar functions. In a roughly similar way, we may designate a note in a Mozart quartet as e.g. the tonic, dominant or leading note of the scale or key of the passage in which it appears. Its entitlement to such a designation is independent of its absolute pitch, and its functional identity can survive a modest amount of variation in the sizes of the intervals that separate it from its neighbours. In this latter respect the diversity of Greek scale-systems gave scope for a good deal more flexibility than more recent conventions permit.

The noun *dynamis* is not used in the relevant sense anywhere in *Pr.* 19. The writers may not have been familiar with this aspect of Aristoxenian harmonics and the associated terminology, or may not have seen its relevance to the issues that concerned them.⁴⁴ But I suggest that when Porphyry says that

43 See e.g. Aristox. *Harm.* 33.4–9, 36.2–14, 40.12–24, 49.2–8, 69.6–11 Meibom.

44 Aristoxenus does not say explicitly, as Ptolemy and Porphyry do, that notes an octave apart have the same function, and if the thesis had been put to him he might not have accepted it without some minor qualifications. It cannot in fact be applied to Greek systems with perfect consistency except in the context of Ptolemy’s “cyclic” conception of the double octave, for which see Ptol. *Harm.* 2.5, especially 52.19–21, 53.10–15 Düring.

while the notes bounding an octave are “opposites,” their *dynamis* is the same, he captures what the Problem-writers mean by saying that the two notes are “simultaneously the same and different,” and that “whichever of them one sings, one produces the same result.” Their high and low pitches make them “different” or “opposite,” but their roles in the prevailing melodic structure are identical; and that is why there is nothing disturbing about the performance of a melody in parallel octaves.

The last sentence of the excerpt from Porphyry is not a borrowing or an elaboration of anything in Ptolemy, who says nothing of this sort and never uses the adjective *antiphônos* or any of its cognates; it is Porphyry’s own independent contribution to the discussion. Its use of the relatively unusual adjective *antiphônos* suggests that it too may have some relevance to our concerns; and when it deploys the concept of equality in connection with the octave we may be reminded of a statement in *Pr.* 19.14 to which I drew attention above: “In the case of sounds, analogy is equality, and the equal is characteristic of the one.” Perhaps we cannot learn much from Porphyry’s comparison of *antiphônoi* notes with *antitheoi* heroes and *antianeirai* Amazons, but at least the sentence suggests, in its context, that a representation of functional equivalence as a kind of equality would not have struck Greek readers as outlandish or perverse. It is interesting, too, that this short passage brings together a group of concepts and terms—the octave, sameness, and difference, the term *antiphônos*, equality—all of which are associated with one another in *Pr.* 19 but in no other surviving Greek text. Porphyry’s commentary on Ptolemy quotes copiously from earlier musicological writings, and he almost always identifies them by name; but he never mentions the *Problemata*, and I have found no indication that he knew the work. We may nevertheless justifiably wonder whether the apparent resonances between 14, 17, and 18 on the one hand and Porph. *in Harm.* 104.5–12 Düring on the other can be entirely coincidental.

2.3 *Physics and Acoustics*

Two passages in *Pr.* 19 consider the phenomenon we call “sympathetic vibration.” The comments in 24 are rather perfunctory; 42, on the other hand, discusses the topic thoughtfully and at some length.

Why, if one plucks *nêtê* and then damps it, does *hypatê* alone seem to resound? Is it because when *nêtê* is ceasing and fading away, it becomes *hypatê*? A sign of this is the fact that one can sing *nêtê* from *hypatê*, for since it is the *antôidê* of *nêtê*, people grasp the similarity from it. And since it is also a sort of echo (*êchô*) of *nêtê* as it is ceasing, and a resonance

(*échos*)⁴⁵ that is the same as the note of *hypatê* is set in motion, it is a natural consequence of the similarity that *nêtê* seems to set *hypatê* in motion.⁴⁶ For we know that *nêtê* is not moving, since it has been damped; and since we see that *hypatê* itself is not damped and we hear its note, we think that it is resonating (*êchein*). . . . Again, it would not be surprising if when *nêtê*, which is very tightly stretched, is struck, the bridge is set in motion. And it would not be unreasonable [to suppose] that when it is set in motion, all the strings are moved with it and produce a resonance. Now the note of *nêtê* is alien to the others both when it is ceasing and when it is beginning, but when it is ceasing it is the same as *hypatê*. When this [sc. the sound of *nêtê* when it is ceasing] is added to the movement belonging properly to *hypatê*, it is not surprising that it seems to belong entirely to that string. And it will be louder than the combined resonance of the remaining strings, because they have as it were been driven by *nêtê* and resonate softly, whereas *nêtê*, which is the most vigorous of them, sounds with all its power. It is therefore to be expected that its *deutereion*⁴⁷ would be more powerful than the others, especially because only a slight movement has arisen in them.⁴⁸

I shall not add much here to my discussion in Section 1 of the idea that when *nêtê* is ceasing it is the same as *hypatê*, which—so I suggested—presupposes the “multiple impacts” theory of pitch. But I would like to make one observation in that connection about the passage’s closing sentences. When the

45 The nouns *êchô* and *échos* do not normally have identical meanings. In most contexts the former is equivalent to our “echo.” The latter can be used of sounds in general, but in discussions of acoustic issues it typically refers to what I call a “secondary sound,” that is, a sound (other than an echo) that is set up by the action of a prior sound. The *De audibilibus*, for instance, consistently distinguishes the resonance (*échos*) set up in the bell of a wind instrument when a note is played from the sound (*phônê*) that arouses it. “Resonance” may not always be the appropriate translation, but it is the best I can offer.

46 Here I translate the text as printed by Mayhew, including the <καί> which he adds at 921b20 (corresponding to the “and” in “and a resonance . . .”). It is possible, however, that the conjunction should not be inserted here but at the beginning of the next clause, giving the sense: “And since it is also a sort of echo of *nêtê* as it is ceasing, a resonance that is the same as the note of *hypatê* is set in motion; and it is a natural consequence of the similarity that *nêtê* seems to set *hypatê* in motion.”

47 On the sense of this word see n. 23 above.

48 At the beginning of the last clause I follow Sylburg and Theodore Gaza (see Mayhew’s *ap. crit.*) in reading ἄλλως τε καί instead of the MSS ὥστε.

note *nêtê* is ceasing it is the same as *hypatê*. Hence when it is added to the note produced by the movement of the *hypatê* string itself, it reinforces it, and we get the impression that this string has emitted the whole of the resulting sound. Here we are apparently to take the thesis “when *nêtê* is ceasing it is the same as *hypatê*” at face value; this phase of an instance of *nêtê* is just as much an instance of *hypatê* as is the note emitted by the *hypatê* string itself. In the next sentence, however, the explanation depends on the premise that even in this phase of its occurrence, *nêtê* is still the most vigorous of the notes and is still “sounding with all its power.” Thus *nêtê* (when it is ceasing) seems to be credited with two simultaneous and distinct identities, neither of which depends on its capacity to set up movements in the *hypatê* string through the medium of the bridge. These are enticing mysteries, but I cannot attempt to fathom them here.

Let us go back to the beginning of the passage, and focus in particular on the third sentence. It tells us that “one can sing *nêtê* from *hypatê*,” an observation perhaps drawn from the schoolroom; the adult teacher sings a note and the young pupil obediently repeats it, but at the higher octave.⁴⁹ By itself the statement poses no problems, but two points associated with it look more puzzling. First, we are told that this is a “sign” of the fact that “when *nêtê* is ceasing it becomes *hypatê*,” which must mean that it provides evidence that this thesis is true; but it is hard to see how it does so, and on that issue I have no suggestions to offer. Secondly, the writer explains the fact that “one can sing *nêtê* from *hypatê*” by saying that one can “grasp the similarity” (that of *nêtê* to the *hypatê* that has already been sung) because *hypatê* is the *antôidê* of *nêtê*. One way of making sense of this would start by assuming that the noun *antôidê* (apparently meaning roughly “answering song”) has much the same sense here as *antiphônôn* does in other passages; and we might also assume that the writer’s allusion to “similarity” echoes the statements in 14, 17, 18, and 19 that the higher note of the octave is “analogous to” and “the same as” the lower, while still being different from it.

When discussing those passages I suggested that the “sameness” or “similarity” consists in the fact that the two notes are functionally equivalent, despite their contrasting pitches. Hence if we follow this line of thought in interpreting 42 we may conclude that the feature which qualifies *hypatê* as the *antôidê* of *nêtê* is again this special kind of musical equivalence. But this sug-

49 Porphyry (*in Harm.* 83.25–84.5 Düring) depicts a scenario in which a teacher sings a note for his pupil to reproduce (though he does not say that he is to do so in a different octave), and gives a rather touching account of the strategies to which the unfortunate child resorts when he cannot do so.

gestion runs into at least two difficulties. First, if “equivalence” were a relevant consideration, we would expect each of these notes to be an *antôidê* of the other. Why then does the writer not say this, but only that *hypatê* is the *antôidê* of *nêtê*? In 17, 18, and 19, where the concept of equivalence is apparently in play, *antiphônōs* is used in the plural, as if it applied equally to both notes; but the writer’s position in 42 seems closer to that of 13, which asks why the low note is the *antiphônōn* of the high but the high is *not* an *antiphônōn* of the low. Secondly, the whole of the remainder of 42, after the statement about the *antôidê*, is concerned with acoustic phenomena and physical movements and interactions which have nothing to do with musical equivalence. While it is of course possible that the discussion falls into two conceptually unrelated parts, it would clearly be preferable to choose an interpretation which avoided this discontinuity, if one can be found.

The second part of the passage has two closely related themes. The first is the now familiar thesis that when *nêtê* is “ceasing” (which I have construed as “completing the string’s cycle of back-and-forth movements”) it “is” or “becomes” *hypatê*, a thesis elaborated at 921b18–21 by the statement that at this moment of its activity *nêtê* sets up an *êchos* which is identical with *hypatê*. The second contention is that the movement of the *nêtê* string is transmitted to all the others through the bridge, and that because when *nêtê* is ceasing it “is the same as *hypatê*,” the combined sound of the two strings is stronger than that of the others, and strikes us as being constituted entirely by *hypatê*.

It seems to me that the description of *hypatê* as an *antôidê* of *nêtê* can be fitted into this scenario quite straightforwardly, independently of the concept of functional equivalence. This *antôidê*, I suggest, is the same as the “*êchos* identical with *hypatê*” that is mentioned a few lines later, and the statement about the *êchos* is designed to explicate the reference to the *antôidê*. There is an immediate objection to this view. The sentence at 921b18 starts with the words ἐπεὶ δὲ καὶ ἡχώ τις ἐστίν . . . τῆς νεάτης ληγούσης, “and since it [sc. *hypatê*] is *also* a sort of echo of *nêtê* as it is ceasing,” where the “also” suggests that we are being given a new point, not an explication of the previous assertion. But this “also” can be differently construed; the sense is not that *hypatê* is a sort of echo of *nêtê* as well as being an *antôidê* of *nêtê*, but that it is a sort of echo of *nêtê* as well as being *hypatê* itself and as such, i.e. the sound produced by the *hypatê* string. In that case the words “and since” mean, in effect, “and since, as I have just said [in saying that *hypatê* is an *antôidê* of *nêtê*],” and there is no longer any difficulty in taking the statements about the *êchô* and the *êchos* as elaborating the allusion to the *antôidê*. All three words refer to the same phenomenon, that of *hypatê*’s production as a “secondary sound” (see n. 45 above) generated by the activity of *nêtê* “as it is ceasing.”

If that interpretation is accepted, it raises interesting questions about the relation between 42 and several earlier passages on the octave, and also about the ways in which the terms *antôidê* and *antiphônōs* are used. In 42, *hypatê* is the *antôidê* of *nêtê* because it is generated as a secondary *êchos* when the *nêtê* string is played. In 13, however, though it is presupposed that *hypatê* is the *antiphônōn* of *nêtê* and that the converse is not true, the explanation seems to be that *hypatê* is larger and contains *nêtê*, which is smaller. *Pr.* 19.12 explicates this thesis about “containment” by saying that “there are two *nêtai* in *hypatê*”; and this points us to 23, which explains the proposition that *hypatê* is double *nêtê* by saying that “when a string is plucked at half its length and as a whole they produce the concord of the octave,” and adding analogous observations involving other instruments. All these passages refer, in one way or another, to the way in which *hypatê* “contains” *nêtê*, so that *nêtê* can be produced by (or from) *hypatê* but not the other way round. Then whereas in 42 *hypatê* is the *antôidê* of *nêtê* because it is produced by *nêtê*, in 13 *hypatê* is the *antiphônōn* of *nêtê* because it includes *nêtê* within itself and (if there is a genuine link with 23) can be used to produce it. The *antôidê* and the *antiphônōn* seem to stand at opposite ends of the causal process.

But we cannot confidently conclude that the words are consistently differentiated in this way. The *antiphônōn* appears also in 7, coupled again with the notion of containment; and here we are told that “the lower note contains the sound of the higher, so that *hypatê* gives out the *antiphônōn* better than *nêtê*.” What *hypatê* “gives out” or “emits” (ἀπεδίδου) must be *nêtê*, and it is *nêtê*, the note produced, not the producer *hypatê*, that is described as the *antiphônōn*. Thus the way *antiphônōs* is used here does not seem to line up with its use in 13. It corresponds more closely to the treatment of the *antôidê* in 42, where the producing and produced notes are the other way round, but it is the product that is the *antôidê*. In general, even if we put the little essays on musical pleasure aside, the passages I have been discussing in this section do not present a consistent picture. Their arguments draw on several different acoustic theories or sets of observations, singly or in various combinations (the “multiple impacts” theory, observations about string-division or the production of harmonics, the transmission of physical impulses through the body of an instrument); most of them treat the lower note of the octave and not the higher as the *antiphônōn* or the *antôidê*, but 7 apparently takes the contrary view; most of them represent *hypatê* as the *antiphônōn* on the grounds that it “contains” and/or generates *nêtê*, but in 7 the *antiphônōn* is the *nêtê* that *hypatê* contains, and though in 42 the *antôidê* is *hypatê*, it is aroused by the activity of *nêtê*. Elsewhere, most clearly in 18 and 19, both notes of the octave are described as

antiphōnoi. The discussions we find in 14, 17, and 18 are radically different from the others, depending as they do on considerations of a strictly musical sort, quite unlike those at work in the passages I have grouped under the heading “Physics and acoustics.” There seems to be no linguistic or conceptual orthodoxy to which the writers of all these passages subscribe; it looks rather as if they constituted a group of musicological enthusiasts for whom the study of the octave was unfinished “work in progress.”

This essay is not designed as a set of interrelated arguments leading to a triumphant conclusion. I have nothing of the sort to offer. All I have tried to do is to put on display some of the intricacies involved in the interpretation of the passages on pitch and the octave in *Pr.* 19, and to look for routes which can take us through their obscurities and apparent stupidities to ideas with some claim to intelligibility. Whether or not I have made any progress in that direction must be left for readers to decide.

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Food and Health in *Problemata* 21–22: Cooking (*pepsis*) in the Kitchen and “Cooking” (*pepsis*) in the Body

John Wilkins

1 Introduction: Nature and Culture

My main aim in this chapter is to understand *Problems* 21–22 in their intellectual context of the fourth century BC or later. At the end I consider briefly their counterpart in Plutarch’s Greco-Roman world of the first and second centuries AD and in culinary science in the twenty first century. In all three eras, the questions raised might be classified as applied science, that is natural questions arising from life lived within a cultural context, such as why bread rises when made with yeast, and what makes you feel full.

Pr. 21 addresses cereal grains, *Pr.* 22 fruits. The questions raised address mainly the preparation and consumption of foods, with a focus on physical and physiological processes. Questions that were essential in medicine from the Hippocratic corpus and Aristotle to Galen, such as what is natural and what is customary, recur here. I discuss these issues in detail below.

Pr. 21 and 22 share many characteristics with the rest of the collection, in particular the interest in medical topics established in *Pr.* 1. The treatment of cereal grasses and fruits in *Pr.* 21 and 22, as well as in 20, is often described as *botanical*,¹ but in fact the emphasis is more on the processed plants—milled grains or ripened fruits on the table, and their effects on the digestive system—rather than the nature and growth of the plant as it might be addressed elsewhere in the Lyceum by Theophrastus. This emphasis on *processed* plants for human consumption brings us close to two important areas of thought in antiquity, the intersection of nature and culture, and the development of nutrition as a branch of medicine.

The first area of thought is the “civilised life,” the “milled grain-life” as it is called in *Woman-Madness*, a play by the comic poet Amphis,² now lost but

1 See e.g. Mayhew (2011, 2–3).

2 Fr. 9 Kassel-Austin.

somehow featuring a life distinguished from that of raw foods.³ There are two issues here: the farming and processing of foods; and the particular culture within which this production occurs, in other words, how *we Greeks* transform the raw products of nature into *Greek* dishes, an area of thought brilliantly discussed by Detienne and Vernant in a system of anthropology derived from Lévi-Strauss (Detienne and Vernant 1989, Detienne 1994). Detienne's anthropological interpretation of nature and culture refers in part to rich material in *Pr.* 20 and others, which considers raw juices, wild and cultivated plants, the effect of raw juices on the body, and many related questions. The caper is a good example (20.12),⁴ for it tends not to flourish in cultivated ground, in this way resembling the famous giant fennel, silphium.⁵ Our author argues that just as the body produces "residues" of humours, so farming produces "more concocted" and "less concocted" land.⁶ Fruit ripens by "coction" (see below), but plants like the caper, which do not grow on farmed land, are corrupted by tending (literally "by education"). Botany and medicine are thus fitted into notions of nature and culture as much as are ethics and politics:⁷ plants are "cooked" as they ripen in agriculture, in a softening process related to cooking food on a fire and to "cooking" food in the heat of the body's digestive system.⁸

The second system of thought is related to the first, namely Hippocratic medicine, in which the raw materials of nature have to be softened by cooking or processing and "civilised" in order to make them easier to assimilate into the human body. The Hippocratic doctors had discussed this process in a number of works—*On Ancient Medicine* and *Regimen 2* in particular—and it is given its most powerful form in Galen's treatise *On the Powers of Foods*, which analyses the human diet under three categories: cereals and beans; fruits and vegetables; meat and fish. In *Pr.* 21 and 22 we have two of these categories, namely cereals and fruits.

Areas of cultural activity under consideration are therefore not the grain fields (which Galen for his part thought he should inspect in person)⁹ nor the

3 See Kassel's and Austin's comments on this fragment (2.217).

4 Radishes are another: see below on Mnesitheus of Athens.

5 Dalby (2003, 303–304).

6 A 'residue' or *perittoma* is an inappropriate accumulation of a humour in the wrong place in the body, normally produced by incomplete digestion.

7 See further Tracy (1969) on the biological basis of Aristotle's conception of what is 'natural'.

8 A peach ripening against a sunny wall and carrots boiling in water would be modern examples. As for digestion, heat is no longer considered to be the main agent but chemical and enzyme solutions.

9 E.g. *On the Powers of Foods* 1.13 on primitive wheats. Throughout Book 1 Galen is interested in inferior cereals as peasants are forced down the food chain in famine; interested, too, in his father's experiments on weeds in the corn crop (1.37).

fruit orchards of Greece, nor the climate and the environment, which are of the greatest importance in Hippocratic medicine. Nor do the *Problems* address questions of provenance, which is a central concern to writers on food, such as Archestratus of Gela (see below), and equally to Galen. It makes a difference to Galen whether, for example, wheat is grown in Asia Minor or Thrace (see n. 9). Our author, by contrast, discusses foods made available in a market, ready to eat and with no provenance, as if the latter made no difference to properties and juices. In discussing food, our author is only interested in how processing and cooking changes the properties and “juices” of foods as they pass through the body, taking particular interest in the taste of a food in the mouth, the colour of a food to the eye, and the nourishment or otherwise that the food might bring to the body. The author clearly follows Hippocratic thought in seeing the processing and cooking of food as essentially the same kind of activity as the digesting of the food in the heat of the body. The *technê* or art of cooking prepares the raw juices of foods for absorption into the body, a kind of preheating for the heat treatment (*pepsis*) of digestion. A discussion in the Hippocratic *Ancient Medicine* (3)¹⁰ brings out the point powerfully: people noticed early in human development that the sick needed a different diet from the healthy, as wild plants that suited oxen and horses were “unmixed and with great powers” not always suitable for mankind. So human beings began to seek nourishment that “harmonized with human nature” (122.7 Jouanna): they soaked wheat, then winnowed it, ground it, sifted it, kneaded it, baked it and produced bread, while from barley they made barley porridge. Boiling, baking and mixing of foods followed and the best name to give to the whole process, the author declares, is “medicine,” since it leads to “the health, salvation and nourishment of mankind.” What the author calls medicine we might call the development of agriculture and the processing of foods within culture. The Hippocratic author, as I have suggested above, sees medicine as a cultural product closely linked with such processing because (pre)cooking over heat anticipates the “cooking” of the human digestive system.

The *Problems* too, not least 21 and 22, intertwine medical and cooking issues. A further element in these, as in many other *Problems* is the nature of the question asked, which belongs more to the modern disciplines of physics and chemistry than some other ancient collections of *Problems*, most notable among them the collection in Plutarch's *Sympotica*.

Our *Problems*, by contrast, ask the question bluntly and out of context (not to say repetitively, which reflects on the collection rather than the original enquiry). In this we may compare them with a number of Hippocratic texts,

10 There are other similarities between this treatise and the *Problems*: see for example Jouanna (1990, 192) on bathing in cold water at *Ancient Medicine* 156.4 and *Problems* 1.29.

most obviously *Aphorisms* and *Nutriment*, where the question or statement is baldly stated, followed by the next equally direct enquiry.¹¹ *Regimen* 2 can be added, for, while less epigrammatic, here too powers of foods, are directly stated, normally without demonstration or justification. Comparison with Galen is instructive since in some treatises (such as *On Simple Medicines*) he *states*, while in others he *argues*. In his huge nutritional treatise *On the Powers of Foods*, he argues and demonstrates, with evidence.

The topics I address here, on fruit and on cereals, were of great interest in the fourth century BC, as seen in the fragments of the doctors Diocles of Carystus, Dieuches, and Mnesitheus of Athens. Theophrastus on plants and Aristotle on the life and reproduction of animals are the headline acts in the life sciences, but the lesser known works¹² increased understanding of the physiology of plants and animals and allowed the authors of *Pr.* 21 and 22 to develop the often detailed accounts of the relationships between food and the human body that had been set out quite widely in the Hippocratic corpus, and in the four books of *Regimen* in particular.¹³

This discussion continued in botanical, medical and other texts through the following centuries, and well into the Byzantine and Early Modern periods. I propose to identify the key issues that influenced the authors, if they belonged to the fourth century, and also those that might have come to bear if composition is to be dated later. In a sense this does not matter as far as the topic is concerned, since ancient medicine, nutrition and botany were fields of knowledge which developed over the centuries after the fourth century, with constant reference back to that period. This is clear in Galen's comments on the Hippocratic corpus and on Plato, in the collections of scholarship in the *Deipnosophistae* of Athenaeus, and in the texts of Galen and Dioscorides on nutrition and medical botany, which depend on Theophrastus' *History of Plants*. A particularly instructive text in this regard is the *Anonymus Londinensis*¹⁴ which draws on the work of Aristotle and Menon, while also referring to Hellenistic doctors

11 For example, *Nutriment* 36: "milk and blood are the surplus of nourishment."

12 van der Eijk (2000 & 2001) has shown the shared concerns of Diocles and some of the *Problemata*. See the index to vol. 2, in particular on the role of residues or *perissomata* in the body and on questions of stickiness and dryness.

13 The latter is an unusual Hippocratic work in following a model of macrocosm and microcosm based on fire and water. Human nutrition, reproduction and wellbeing were all founded on these elements which were reproduced in the body in terms of body heat and the vital fluids of the body. Despite the apparent different cosmology from the humours found elsewhere (four uniquely in *Nature of Man*), the understanding of the body in *Regimen* 1–4 does not differ radically from that of other Hippocratic writers.

14 For the text see Manetti (2011).

such as Herophilus and Erasistratus. That text features questions of nutrition and the humours of the body in ways that resemble *Pr.* 21 and 22 here discussed. Like the *Problems*, and the *Deipnosophistae* which contains much peripatetic work on food and medicine (including the *Problems*), the *Anonymus Londinensis* appears to contain Aristotelian and early peripatetic material.¹⁵

As regards questions that derive from the domains of cooking, medicine and botany, the first two are similarly found in close proximity in some Hippocratic treatises where cooking is either the precursor of digestion in the body, as we have seen in *Ancient Medicine*, or offer an analogy for a bodily process, as seen in *Regimen* 1.18. Here, cooking and music are considered together as an analogy to show “that arts are manifestly similar to affections of the body” (12). Cooks mix ingredients together, some the same, some not, to make food and drink. There would be no pleasure if all ingredients were the same. Similarly with music, notes are different, some “sweet,” some “sharp,” some discordant, some concordant. When the tongue is nicely tuned, there is pleasure in the combined sound (*sumphonie*), but in a tongue out of tune there is pain. The point seems to be that a combination of different elements and tastes is needed in cooking, in music, and, by analogy, in the body.¹⁶ In *Ancient Medicine* 14, analogy and cooking itself are at play. The body is affected by differences in bread, the sort of flour, the sort of kneading, the amount of baking: “by each one of these things the human being is affected and altered in one way or another, and a person’s whole life depends on them, whether he is healthy, recovering from illness or sick” (14.2 [Schiefsky trans.]). This is the most useful and necessary information to know, the author continues. Human beings are a blend of salty, bitter, sweet, acid, astringent, insipid and other tastes, which, when mixed together, are not obvious and cause no pain. Therefore, foods when mixed together are beneficial: both separation and the predominance of any one are harmful.¹⁷

This type of reflection is a predecessor of what we find in *Pr.* 21–22, which are questions deriving from cookery, medicine (the latter with its strong emphasis on concoction in body heat), tastes and humours, and the intersecting properties and functions of foods and bodies. Mixtures, kneading and

15 On Aristotle’s medical work, corroborated by Menon, see Galen’s *Commentary on the Nature of Man*, 15.25 Kühn. For the ascription of this work to Aristotle, see Manetti (1999).

16 Interestingly, in other, more moralising, contexts, many different flavours are identified as ‘luxurious’. This medical writer sees the body’s need for such nutritional variety.

17 See the notes on chs. 14 and 20 in Schiefsky (2005), on cheese, a complex product of curds and whey whose different properties harm some and benefit others, since, as Hippocratic authors regularly stress, different people have different natures.

flavours are very much to the fore, though it is not always possible to discern quite why the author has raised the question he has. Is it a practical question? A cooking question? A medical question? The five senses are frequently a key issue: colours (e.g. *Pr.* 21.15), tastes, smells, along with pleasure and pain, and fullness (21.14).

2 Tastes

Aristotle has an important discussion of colour, smell, and taste in *DA* 2.10. In *DA* 2.2–3, Aristotle identifies nutrition in plants and touch in animals as key to sustainability, the latter linked with pleasure and pain and hunger and thirst, while “flavour” (*chumos*) is a kind of “seasoning” of hunger and thirst (414b13–14). When the discussion moves on to human beings (2.10), moisture is an important vehicle of taste, leading to the role of juice (*chulos*), which allows *chumos* to function. At *DA* 2.9.421b1–2, basic smells, which are linked to tastes, are sweet (saffron and honey) and pungent (thyme).¹⁸

Colours, tastes, flavours and other sensations introduce a further fourth century preoccupation, just noted in *De anima*, that is addressed in a fresh way in *Pr.* 21–22, namely pleasure. For our author, pleasure is a feature of human physiology, a sensation deriving from the senses of smell and taste, and not necessarily something to be deplored. This runs against the problematic role advanced by Plato in his approach to pleasure, which resonated particularly in relation to food. Socrates in the *Republic* prefers to limit food in the ideal city to vegetarian dishes eaten to the accompaniment of hymns, excluding the varied dishes of fish and meat “which we now have” in the “luxurious” city. In *Gorgias*, meanwhile, the work of the cook is seen as a meretricious skill promoting pleasure, in contrast to the doctor who attends to the health of the patient (462d–65d).

18 See further Hicks (1907) and Polansky (2007, 188–94 and 314–20). Aristotle’s assessment of saffron is not shared by others. *Larousse Gastronomique* 1012 and *The Oxford Companion to Food* 680 declare saffron pungent and bitter. Yet saffron can be warming: “Saffron rice is gently spicy, saffron sauce will be softened by olive oil, butter or cream and of course there is a west country tradition of saffron buns and custard. Presumably the edgy taste of the saffron contrasts well with softer, warmer influences rather than anything terribly powerful that might overpower such an expensive ingredient. The perception will then be of sweetness by association” (Shaun Hill, personal correspondence). Galen (*On Simple Medicines* 12.48 Kühn) says saffron is astringent, a quality linked with earthiness and cold, but also heating. Aristotle might perhaps have chosen a less complex example of ‘sweetness’.

Plato's ideas could be taken in two directions by later writers. Archestratus of Gela (on whom see below) and a number of comic texts extended them, dwelling on the pleasure of eating expensive fish with an underlying recognition that unrestrained appetite was the sign of social deviancy.¹⁹ Certain foods were so seductive that the enthusiastic eater should even steal them to increase his pleasure (Archestratus fr. 22 Olson and Sens). Equally, food fitted easily into Aristotle's ethical scheme, with a man in need of moderate rather than unregulated enjoyment (see *EN* 1.14 on pleasure, appetite and pain). Our *Problems* follow this criterion of moderation.

But within *medical* thought, the senses are key diagnostic tools and indicators of body function. In the Hippocratic *Epidemics*, body colour and the colour of faeces and urine help to reveal the patient's internal condition to the doctor.²⁰ Our author addresses the colours of foods at 21.3–4 and 15 and 18 (see below on Galen), while taste is at issue at 21.19, 22.2–3, 5 and 11. Similarly, tastes and flavours are related to humoral qualities (*chumoi*) within the body; and the flavours of plant and animal juices (*chuloi*) have an impact on the body's humoral balance. Our author refers to these juices at 21.12 and 22.7, linking them with pleasure at 22.8. Further reflections on pleasure are found at 21.13 and 14, with pleasure linked to juice at 22.7 (roasted nuts are best when hot, and bread and acorns when re-heated).

This impact of plants on the body was addressed in the fourth century by Mnesitheus of Athens (fr. 25 Bertier) and later discussed by Galen (*On the Powers of Foods* 2.59). Mnesitheus was interested in such medical-botanical questions as the different *dynameis* of the root, seed, leaf, and stalk, and their impact on the human body. Mnesitheus asserts that the roots of plants are difficult to digest and disturb the stomach, explaining the phenomenon in terms of uncooked food: the root of the onion or the radish is a kind of reservoir of moistures (*hygrotes*)²¹ that are “not cooked” in the root since they reach completion in the shoots and leaves of the plants they nourish. Galen approves the teleological base of Mnesitheus' argument but claims that Mnesitheus is in error, since a radish root is more acrid, and thus more finished in acridness

19 See Davidson (1997).

20 For example, in *Ep.* 3.5, “the faeces contain bile, are scanty and unmixed, the urine is light (*lepta*), not of a good colour . . . [later] of a better colour.”

21 Slightly differently from Mnesitheus, Theophrastus (*History of Plants* 1.7.2) uses the term *chuloi* for plant juices, but observes, “the juice of roots is pretty fearsome . . . which is why some are bitter whose fruit is sweet.”

than the leaf.²² For Galen, more acridness implies a more complete radish-ness. But for our author (20.11) thin radishes are more acrid and larger ones “riper,” implying a more complete radish. 20.13 adds that the larger radish is more nourished.

Arguments about rawness, pungency and flavour recur in the *Problems*. *Pr.* 20.6 explores the basic question, why some plants are edible and some not. The crucial matter is their *chumoi* or juices. Raw juices may be changed by heat, which renders them edible; otherwise they remain inedible. These *chumoi* are both flavours and vital juices that in many medical authors are humours. The *chumoi* and *chuloi*, related vital juices, were further discussed by Mnesitheus.²³

A further root with pungent juices of interest to the author of *Pr.* 20 and equally to Galen is the onion and other alliums, plants with little *nutritional* value (energy or calories in modern thought) but with important thinning qualities for those with thick humours, hence at the top of Galen’s list in *On the Thinning Diet*. By nutrition (*trophe*), Galen means energy (best provided by cereals and pork), though he concedes important related properties to green plants and vegetables, which may determine, for example, how quickly food passes through the intestines, and thereby the absorption rate of nutritious foods. These properties too may be modified by preparation and processing. It is clear that the author of our *Problems* is addressing cultivated foods and their modes of processing and preparation, sharing, as we have seen, the Hippocratic preoccupation with processing foods as a form of pre-digestion for the human stomach and gut. This is an approach to food very different from what the Stoic philosopher Musonius Rufus was later to argue, that rawness and minimum preparation of food was to be recommended in order to achieve the highest level of philosophical purity. Medical writers, by contrast, ever fearful of the impact of raw juices on the body, sought out the fine distinctions between coarsely-ground and refined flour (*chondros* and *aleuron*, among other terms), and all emphasised the value of barley water (*ptisane*). The Hippocratic author of *Regimen* 2 considers the overall effect of wheats to be (42) “stronger and more nourishing than barleys, while they and their *chuloi* are less laxative.” As for the processed forms of wheat, oven loaves are more nourishing than loaves cooked in the hearth or on a spit, and those baked under a dome or in ashes are driest. It is at this, processed, end of the range of foods that the author of our *Problems* focuses his attention. *Trophe*, nourishment for the body, is the key

22 Bertier (1972, 183) compares *Regimen* 2.54, where the Hippocratic author declares that the radish “moistens by ‘pouring through’ the phlegm with its acidity.”

23 See frs. 10–16 Bertier, and her overview (1971, 30–32).

objective, as it is for Galen, who similarly focuses on the physiological effects when eating different kinds of bread and cake.

3 Cereals and Textures

Barley is mentioned first, but wheat is of much more interest. Echoing *Ancient Medicine*, wheat “fits” (*armottei*) the human body better, according to 21.2. The scientific questions that the writer has seen fit to raise (often related to sensory perceptions such as taste and colour) thus have a considerable medical application. For this author wheat is most suitable, but for the author of *Regimen* 2, barley must come first. (Perhaps this is because, like Galen, the Hippocratic author wants to cover the most commonly consumed foods rather than the theoretical best. Perhaps the author of *Pr.* 21 and 22 does not suffer from this constraint.) In the fifth and fourth centuries, the majority of Greek people seem to have subsisted on barley, a crop much more suited to Greek climate and soil than the hungrier wheat (Garnsey 1988). Wheat was desirable if it could be afforded. Barley could give strength (Thucydides 3.49), but was less desirable, less “nutritious,” and less palatable (though see below, interestingly, on Archestratus fr. 5 Olson and Sens, which makes considerable claims for refined barley). A key drawback of barley was its lack of gluten which made it a disappointing bread flour in comparison to wheat. Barley was normally eaten as flatbread or maza (barley porridge or barley cake, eaten in various forms of wetness and dryness and with flavourings such as onion and garlic). Barley also had myriad medical applications, as the food to aid recovery in the patient who was convalescing and gradually increasing in strength from an ability to absorb first barley water, leading to steadily greater concentrations of solid materials. *Ptisane*, or barley-gruel, indeed, is the Hippocratic convalescent food par excellence and the preparation with which *Pr.* 21 begins.

After *ptisane*, the author considers *aleuron*, flour, almost certainly wheat flour. Oil and cereal are mixed together, and nourishment for the body is the result. To nourish the body, our author continues (21.2), stickiness is needed, to help the food material to adhere (*prosphunai kai prokollesthai*) to the gut wall or perhaps to slow its passage through the intestines, along with an ability to be absorbed into the body and successfully transformed into blood. More kneading was used for barley flour, which was normally kneaded (*mattesthai*) to make *maza*. The more it is kneaded with water, the author says, the stickier (*glischrotera*) and more difficult to concoct or digest, on account of concoction needing smaller parts (see below). Desirable stickiness for adhesion is thus counterbalanced by the undesirable effect of slowing absorption. Related

questions arise of water (21.4) and salt (21.5), the latter on its preserving and drying properties.²⁴

Our author is concerned with what we now know as the gluten in wheat flour, which is stretched by kneading and expands with the carbon dioxide produced by yeast, all activated by the addition of water or other liquid to make a malleable dough (McGee 2004). Barley, with little gluten, has little ability to expand. External stickiness is taken to mirror the passage of the bread through the gut.

These questions derive from Hippocratic thought. As we have seen, *Regimen* 2.42 reviews the nourishing properties of cereals and the speed of passage through the body. Galen adds the stickiness or friability—the texture—of the dough as key considerations. Our author shares much with Galen's extensive discussion of the stickiness of wheat breads in *On the Powers of Foods* 1.2 and barley breads in 1.10. Galen directly addresses the questions of our *Problem* on stickiness and friability (1.2), and our author's questions on the colour of flours; the action of yeast; the actions of air, water, and oil in various doughs and bread mixtures (1.1; 1.4; 1.17; 1.18; 1.22; 1.23; 1.24; 1.25). On wheats, Galen writes (1.2, 217.4–218.3 CMG):

the most *nutritious* of them are the dense ones with their whole substance compacted, so that it is difficult to split them by biting. They give bodies the most *nourishment* from the smallest bulk. . . . They are also more *yellow* in colour than the loose-textured ones. But one should test their nature, not simply by examining the external appearance, but by dividing them and breaking them up. . . . For although many from the outside appear yellowish and compact, inside they are seen to be loose-textured, porous and *white*. These latter have the most bran and, when milled, if one sifts out the very fine meal and makes what are called bran loaves from the remainder, trial will show that while they are poorly nutritive they produce much *residue* in the stomach and consequently it is passed easily. . . . Loaves that are . . . extremely pure . . . [produce dough that] is quite sticky so that it is stretched to the maximum and not torn apart, which is the peculiarity of a *sticky* material. With reason, then, these need more *yeast* and are in greater need of being softened [by *kneading*] (trans. Powell 2003, adapted).

I have italicized terms Galen shares with our Peripatetic author. Like him, Galen brings out the importance of practical experiment and observation,

²⁴ On preserving with salt see for example Galen, *On the Powers of Foods* 3.40.

with added complications for different varieties of wheat, a possibility not raised by our author. On barleys, Galen writes (230.21–23 CMG):

people make barley loaves similarly to wheaten ones. They are not only more *friable* than wheaten loaves, but than emmer and einkorn as well, since they have nothing *sticky* inside them like those wheats. Clearly, then, they provide little nourishment to bodies . . . (my translation).

Galen does not mention kneading barley loaves, which our author does do (1.2), but he does judge barley flours by colour. In short, Galen's medical science shares with our author an interest in nourishing qualities of cereals, texture, colour, action of yeast and other changes produced by the mixing and kneading processes. The science of the kitchen we might say, and how that acts on the science of nutrition.²⁵ Together with the evidence of the senses, taste and smell in particular, the evidence of texture and physical properties adduced in the kitchen can be transferred by inference to the processes active inside the body.

4 Parts of the Body

The author of *Pr.* 21–22 addresses parts of the body directly relevant to the digestive process, namely teeth and gums (22.14), tongue and the pores of the tongue (22.5, 22.11), and stomach (21.13, 22.3), and with only slight allusion to how the food is absorbed into the blood stream and distributed through the body. In this he resembles Galen, who in the works on nutrition addresses parts of the body connected with eating, that is the teeth, tongue, stomach (in particular the cardia or upper part of the stomach), and the oesophagus, with the major discussion of how it all works reserved for example for his *On the Use of Parts* and *On the Natural Faculties*. Our author may depend for details on residues collecting inappropriately in the body (*perissomata*) on Diocles and Mnesitheus, as well as on Aristotle. A concern that is found in Aristotle, and survives through to Galen is the matter of the size of food particles or *mere*. Some foods have finer, others thicker particles. These properties determine the speed of absorption into the body (*Pr.* 21.24–26).

²⁵ Galen's interests share many concerns with our text. We do not know exactly which texts Galen is drawing on in addition to his own experiments, since many texts on Greek nutrition have been lost. For the overall picture see Wilkins (2013).

As far as the stomach is concerned, a person may feel full because rich foods are floating at the top of the stomach (*epipolastika*) and not being absorbed into the body as they should. The phenomenon is mentioned at *Regimen* 2.54.2, where the radish root is said to be bad for arthritic conditions, as it is *epipolazon* and hard to digest. Galen refers to this in his treatise *de sanitate tuenda* (6.10, 189.9–190.11 CMG), on lack of tension at the top of stomach caused by astringent foods sitting there on the surface. And at *On the Powers of Foods* (2.19, 287.21–22 CMG), peaches must not be eaten after other food “as they lie on the surface and corrupt.” Galen explains at some length that this will be brought about by the nature of the food—astringency in pears—and the constitution of the patient—in this case one prone to poor toning in the stomach muscles. Food floating in the stomach leads to only partial, and not final, concoction. Where Galen notes this in astringent foods, *Pr.* 21.13 notes it with pleasant foods. Oily, sweet, and fat do this (like olive oil floating on water). A feeling of fullness, therefore, may arise from *lack* of stomach action as well as sufficient distribution of food through the body. The area of concern for our author, as for Galen, is the upper part of the stomach.

There is more exploration of fullness in *Pr.* 21.13 and 22.2. The body may be nourished more by bread and astringent wine²⁶ than by sweet and pleasant titbits. Our author suggests (21.13) that the body prefers what is in harmony (*summetra*) with it and proper (*oikeia*) to it, in accordance with nature and not opposed to nature. This is later endorsed by Galen, who emphasises that the body needs nourishment as similar to itself as possible, to minimise the danger of residues (*perittomata*). Food that is “natural” for the body, such as mother’s milk, is the most likely to be fully assimilated. Few other foods can match this, but medical advice can direct the patient to the foods most needed for the individual’s particular “nature” or constitution. *Pr.* 22.2 is concerned with pleasurable aspects of fullness, sweet being more desirable but quickly satiating. Possible answers are that sweet things are more nourishing, while acrid (*drimu*) things nourish little and produce residues, and may consequently stimulate appetite in order to provide enough nourishment.

5 Physical Questions about Desserts (*tragemata*)

We have just seen that fullness is a matter not only for the cereals of *Pr.* 21 but also the fruits of *Pr.* 22, with some reference to meal times. The order of

26 *Oinois* . . . *austerois*. I disagree with Mayhew’s “unadorned wines”: tastes are important in this discussion.

foods eaten arises in *Pr.* 21, where food is found to change in taste if eaten after something contrasting (21.19); this continues in 22.5, where wine seems more bitter after eating rotting fruit; and in 22.11 where wine and water appear sweeter when eaten with astringent flavours such as myrtle berries or acorns.²⁷ Mealtimes are taken into account implicitly, with no strong move from the kitchen to the dining area. In *Pr.* 22, moreover, there is some discussion of drinking wine with food, which normally happened after the *deipnon* or main courses, and during the symposium when “second tables” or *tragemata* (very close in sense to modern “nibbles”) were served. These might be sweet or savoury: see, for example, Archestratus fr. 60 Olson & Sens, which includes sow’s womb, silphium, and the figs and fruits discussed in our text.²⁸ At 22.6, the function of “nibbles” and wine might be not only to satisfy thirst arising *when* eating food, but also *after* food. The issue of the order of foods entering the stomach is again to the fore.

It can be seen that the physical questions of the *Problemata* intersect with the codes of dining. At 22.8, figs are best with unmixed wine or water, liquids always drunk mixed according to the codes of Greek symposia (the gods alone were offered unmixed wine). This question closely resembles an issue in Heraclides of Tarentum, a medical author of the first century BC who was influential among Galen’s rivals, the Empiricists. Athenaeus reports that Heraclides wrote a book entitled *Symposium*, which, like Plutarch’s sympotic works, appears to have bridged the gap between medical and food texts. According to Athenaeus (3.79e), Heraclides “asks the question” whether hot water or cold should be taken after eating figs. The case (reported from others) for hot water is that it cleans hands and so is thought to dissolve figs in the belly. The case for cold is that it is heavier and forces the unsympathetic figs down into the stomach. Unmixed wine helps this process too. The combination of a question, water, unmixed wine, analogies from the external body to understand the inside, and the place of food in the belly (high up or down below) make the interrelationship of the passage with ours fairly secure. Athenaeus’ report that Heraclides is bringing forward the arguments of others makes intermediaries possible, if the *Problemata* themselves were not Heraclides’ source. The underlying physics in both these questions concerns mixtures of fire and water in the body, rather like the principles of *Regimen* 1. Water and heat continue in *Pr.* 22.11 (the action of water with sourness) and 22.12 (the effect of heat on sweetness).

27 On the astringency of myrtle berries, see Galen *On the Powers of Foods* 2.18, on acorns 2.38.

28 Mayhew limits *tragemata* to “dried fruits,” a subset of this type of dish.

Figs prompt a further question (22.9), why do multiple cuts allow more evaporation of the substance of the fig? Evaporation is an occasional question in *Pr.* 21 and 22 (even about the complexion of flour workers in 21.24), and Galen addressed similar questions about air-tight containers (*On the Powers of Foods* 2.9, 277.25 CMG).

6 Plutarch's *Problemata*

Questions based in physics which underlie physiology resemble Plutarch's question (*Symposiaka* 3.3) about why women get drunk more slowly than old men. That is a medical question that might more often be posed as a social question, and reminds us that the scientific questions in this section on deserts arise principally to mind when men are enjoying each other's company reclining over wine at the symposium.

For questions of this kind, we can look to Plutarch's *Symposiaka Problemata*, popularly known as *Table Talk*, and to the modern food scientist, Harold McGee.

Plutarch's approach to the kind of questions that constitute "problems" is most interesting. He announces at the beginning of the work (612e) that he thinks it is worthwhile to record for posterity conversations that arose during symposia. Such an occasion differs from the apparent learned environment of our Peripatetic "problems" but there are shared elements. The Greek symposium, in addition to its drinking and social role at the heart of Greco-Roman male society, was also a forum for learned discussion and poetry, as is shown pre-eminently in Plato's *Symposium*. The Theory of Forms is not out of place at such an occasion. Plutarch's speakers fall short of the intellectual power of Plato's Socrates, but the kind of question they pose and the kind of discussion that raises answers are similar to those found in our collection. "On ivy, whether it is hot or cold by nature" (648b); "Why do women get drunk less quickly than old men?" (650a); "Whether women are colder in temperament than men or hotter?" (650e); "Whether wine is fairly cold in its power" (651f); "On the right time for sex" (653b): these are some of the questions for debate in the third book. Of course, Plutarch's questions are chosen for the occasion of the symposium and accordingly address appropriate issues of sex and drinking. But they are scientific questions in the sense that they are based on biology and medicine. The coolness of women is a central Hippocratic concern, as are the timing and circumstances of conception; the nature or power (*dynamis*) of a plant is a central concern of Galen, who discusses vines in his *On the Powers of Food* and ivy in *On Simple Medicines*. At *On Simple Medicines* 12.29–30 Kühn,

Galen declares that ivy is both heating and cooling, the basis of the conversation among Plutarch's guests. Plutarch thus brings scientific questions out of the technical area into more popular forms. In addition, he makes his learned conversations open and constructive (König 2007): a spirit of enquiry prevails over dogma, very similar to the endless questions and alternative answers of our Peripatetic authors.

7 The Science of the Kitchen

A number of the questions asked in *Pr.* 21 may be answered from the perspective of modern science by McGee (2004). Questions of blending, of bread rising, and of stickiness and friability arise from observation of cooking processes and the preparation of food. They are physical and chemical questions for modern science, based on emulsions, molecular layers, protein layers, and so on. On the stickiness and water content of bread discussed above, McGee observes:

Gluten proteins form long chains that stick to each other. Gluten is a complex mixture of certain wheat proteins that can't dissolve in water, but do form associations with water molecules and with each other. . . . Little water gives an incompletely developed gluten and a crumbly texture; a lot of water gives a less concentrated gluten and a softer, moister dough and bread. (2004, 521–24)

These questions are important in ancient science, along with all the other hundreds of questions posed in the *Problemata*, but they arise initially in the kitchen (not a big space in many ancient houses) or food preparation areas from people mixing bread dough and making other preparations and sauces. These preparations had more than culinary interest in antiquity since the pre-cooking of foods in the kitchen could be a clear indicator of how the food would be processed in the body, “cooked” in the digestive process, and distributed through the body. Similarly, the questions arising from taste are culinary and pleasurable, but also have a medical dimension since tastes were closely tied to the juices of the plant (*chuloi*) and the juices of animals and human beings, which overlapped with the humours (*chumoi*). Harold McGee has brought science into the kitchen, but observation for large areas of ancient science, medicine in particular, had a regular place there.

We might add that the questions asked in *Pr.* 21 are much more likely to be answered in a medical text such as Galen's *On the Powers of Foods* than in a cookery book. Archestratus of Gela, whose *Hedypatheia* of the fourth century

BC is our earliest surviving cookery book in Europe, concentrates on the procuring and cooking of fish, the highest status food of the period. The *Hedypatheia* (*Life of Luxury*) is a cookery poem that appears to have been framed for performance at a symposium (Wilkins forthcoming; Olson and Sens 2000), rather like Plutarch's fictional "problems." Archestratus does not discuss baking bread extensively. In the only fragment to survive on the subject (5 Olson and Sens), he identifies a Thessalian bun made by kneading one of two rough barley flours (*krinnites* and *chondrinos*) thoroughly by hand into a round shape. The cookery book shares with our author an interest in texture, shape, and kneading. In other words, our author poses scientific questions about texture, taste, and colour, which derive from processes in the kitchen and on the table.

In this chapter I have tried to show, through the medical science of Galen and the modern science of Harold McGee, that answers are available to the questions set in *Pr.* 21–22. The answers inevitably change with time and culture, but the fact that they continue to be forthcoming centuries later demonstrates the importance of those original questions raised in the Lyceum.

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On *Problemata* 23: Little Problems on the Vast Sea

Malcolm Wilson

Homer's most memorable images of the sea draw on our immediate experience, its far-crashing waves (ἐπὶ θινὶ πολυφλοίσβοιο θαλάσσης *Il.* 23.59) and its wine-faced surface (οἶνοψ πόντος, *Od.* 6.170). Such images function as symbols of desolation and error, and play their roles in eliciting emotions peculiar to the epics. But Homer also gives the sea cosmic significance beyond our immediate experience. Thus Ocean is the eternal frame of the world within which the scenes of men are played out (*Il.* 18.607–608) and the boundary of Hades (*Od.* 11).

The Ionian natural philosophers chose to pursue these latter, cosmic concerns, and in this context the sea plays the role of first principle, the aboriginal water that feeds the sun and the stars with its vapor. This grander cosmic perspective frames and conditions the philosophers' questions and their answers, and even in the diminished role to which it is relegated in the later tradition by Plato's *Phaedo* or Aristotle's *Meteorologica*, the sea remains a part of the grand cosmic architecture, the reservoir for the system of infernal rivers or a kind of cosmic bladder. The chief questions for the philosophical tradition, when they are not about psychology (Heraclitus) or ethics (Plato), are about the origin of the sea and its relationship with rivers, the reasons for its present confinement in the hollows of the earth and its salinity. These questions are related to one another and tend to receive related answers.

The early philosophical tradition, then, had a remarkably narrow and highly theorized problem set.¹ Theophrastus is the first, so far as we can tell, to consider more modest and specific questions—his *De aquis*, at least, provides considerable detail about the various tastes of water (214A FHS&G).² But it is with *Problems* 23 that we return more consistently to Homer's world of immediate experience: why do waves billow when the wind is still? why is the sea now white, now dark? why is the sea good for cleaning clothes? why does it produce loose stools? Though it is not appropriate here to discuss in any detail the purpose of the *Problems* as a whole, it is important to ask what the purpose of this shift is in book 23. No doubt my observations may have wider significance, but I shall not pursue them in this paper.

¹ Though no doubt this is partly the result of Aristotle's doxographical selection.

² He also considers general causes, e.g., of the salinity of the sea (220 FHS&G).

1 Methodological Observations

We must start with some general observations. Flashar has already observed the tendency to frame problems as paradoxes, and in a certain sense this holds true of *Problems* 23 as well.³ One need only consider 23.22 (why does salt water dissolve salt more quickly than fresh water does?) or 23.30 (why are the upper parts of the sea saltier and hotter than the parts in the depths?) to confirm this observation. But the *Problems* is not just a paradoxology, and to bring us to a closer understanding of the purpose of the work, Flashar contrasts our *Problems* with the “genuine” Aristotelian problems, i.e., the ones Aristotle mentions in his works and discusses in the *Topics* and *Posterior Analytics*. He notes that the “genuine,” i.e., Aristotelian, problems are not the “sum of the natural knowledge of Aristotle,” rather they are the place where “particular questions are handled that presumably were not philosophically central.”⁴ In our *Problems*, by contrast, he sees an encyclopedia of knowledge, an attempt to unify the various sciences, which were by the time of its composition going their own independent ways under practitioners who lacked Aristotle’s unifying vision.⁵ Flashar draws no connection between the paradoxical style and this wider purpose.

This view, however, is not consistent with what we find in *Problems* 23. First, an encyclopedia of knowledge would require a systematic treatment of the subject, and would include the most general principles and the most important questions. But the range of problems we find in *Problems* 23 precludes this. Instead we find small problems, none involving the grand questions of the philosophical tradition. They correspond rather to Flashar’s description of the “genuine” Aristotelian problems, those that fall below the level of philosophical interest. Now, the discussion in the *Analytics* leads us to believe that the problems are the beginning of the process of discovery and a source for theoretical explanation. On this model we gather problems and discern patterns that help us grasp the appropriate middle terms.⁶ *Problems* 23 is not the direct result of such a process, but it can be understood as what is left behind

3 Flashar (1962, 299); joined by Centrone (2011, 12) and Quarantotto (2011, 26), who notes the use of θαυμαστόν and ἄτοπον in the *Problems* (though these words are not used in book 23).

4 Flashar (1962, 315). Quarantotto (2011, 34) goes so far as to claim that our *Problems* conforms to the model of science as it progresses from ὅτι to διότι laid out in *APo.* 2. She describes the *Problems* as *una raccolta di indagini causali più o meno accessorie rispetto alle ricerche svolte negli altri logoi* (36). She has shown how the *Problems* often treats briefly and superficially what Aristotle treats in depth and at length.

5 Flashar (1962, 322–23).

6 *APr.* 1.26–31 and *APo.* 2.14–17; for more on Aristotelian problems, see Lennox (1994), who offers a convincing reconciliation of dialectical and demonstrative problems.

when the grand and general problems are solved and removed, and this view finds corroboration in Aristotle's description of problems about the winds in *Meteorologica* 2.6:⁷

Let us go on to the positions of the winds and their mutual relations of opposition, and describe which kind can blow simultaneously and which cannot and what are their names and numbers, besides dealing with any other of their characteristics that have not already been treated as separate (κατὰ μέρος) problems. (2.6.363a21–25 Lee trans.)

It appears that the subjects of *Meteorologica* 2.6 and the “problems” mentioned in this passage are mutually exclusive, and that Aristotle is including in the *Meteorologica* material that would normally be considered in the problems. The salient phrase is “separate” (κατὰ μέρος), which implies “specific” rather than “general.”⁸ The “problems” would then be a residue of the process of solution and incorporation into a larger theoretical framework. Now, this passage occurs in the context of an unusual chapter, a chapter on the minutiae of winds. In effect, Aristotle is saying that this chapter deals with the minutiae that have not already been dealt with in the “problems,” that the problems included in 2.6 have nothing to do with the grand theory. And this seems to be a fair description of the chapter. It is important to remember that the *Meteorologica* makes no mention of the famous, but specific, problem of the Nile and, though our *Problems* does not mention it either, book 23 keeps its problems at a low level of generality, sometimes even descending to particulars like the Black Sea and the coast of Libya in a manner that recalls the κατὰ μέρος tag.⁹ These facts suggest a division of labor between treatise and problem that would require a clear recognition of where each item would ultimately belong. I do not intend to imply that our *Problems* 23 is the residue of Aristotle's *Meteorologica*, but

7 Mayhew (2011, 156–57) notes that some of *Problems* 26 may be problems Aristotle alludes to in his *Meteorologica*. All translations are taken from the Loeb Classical Library unless otherwise noted.

8 Aristotle reiterates the distinction at the end of the chapter: τῶν συμβαινόντων κοινῇ τε παθημάτων καὶ περὶ ἑκάτερον (365a12).

9 The *Vita Hesychii* notes a περὶ τῆς τοῦ Νείλου ἀναβάσεως attributed to Aristotle. It has been identified with the Latin version (Rose 1886, 248). This Latin version follows a very different method from anything we find in the meteorological books of the *Problems*. See Bodnár and Menn in this volume.

I think it is unlikely that book 23, lacking as it does the general component, is part of an epitome of Peripatetic knowledge.¹⁰

Most interestingly, these considerations make better sense of the paradoxical nature of many of the problems.¹¹ We can now see that paradox per se is not the aim here; rather the problems in book 23 are unexpected, because they do not fall obviously under some more general cause and explanation. They are exceptions. We can also see that these problems presuppose a more general explanatory framework, though the consistency of this framework from problem to problem is not of paramount concern. Thus, in the problem mentioned above, why the upper parts of the sea are saltier and hotter than the parts in the depths (23.30), we expect the seawater to be heavy because that is part of its most basic nature. This problem does not overturn that general truth, but it does require an auxiliary cause (surface evaporation), which operates together with the general nature of seawater to explain the unexpected result.

When we consider the range of problems in book 23, we see that there are roughly three kinds of auxiliary causes at work:

1. As I have already described, some problems concern special cases, species of a genus, as it were. So perhaps 23.31 (why are the parts of the sea by the land sweeter?) fits the description, inasmuch as it deals with a specific kind of sea.¹²
2. Some problems, without being species of something dealt with in a *Meteorologica* (again, I am using *Meteorologica* only as an example of a treatise), are not relevant to the grand scientific structure. Such problems are very numerous (swallowing of ships (23.5), washing clothes (23.40), producing loose stools (23.39)). Often they are interdisciplinary and involve considerations from outside of the immediate subject matter.

10 It is worth noting that the five problems published at the end of the *Supplementa Problematorum* (Kapetanaki-Sharples, 2006) all derive from clear sources (Olympiodorus and more remotely Aristotle), and these are more (though not completely) connected to Aristotle's inquiry.

11 The connection is noted by Quarantotto (2011, 26): *Spesso il carattere aporetico del fenomeno che è oggetto di indagine è presentato con formulazioni di tipo, per così dire, paradossale: il fenomeno non è problematico in sé ma alla luce del confronto con altri fenomeni che per qualche aspetto gli sono simili o affini.*

12 It is remarkable that species of a genus are hard to find. Instead, Pontus is compared to the Aegean (23.6), rather than to seas in general; northern seas are compared to southern (23.9). By contrast, in *Problems* 26 questions concerning specific winds, e.g., Notos, Boreas, are very common. This is no doubt due to its connection to *De ventis*, which aims at discussing particular winds.

3. Some problems represent inversions of standard, general rules, for example, why the surface of water is saltier than the depths (23.30). Such cases are akin to explanations from deformation in the *Parts of Animals*, which use appropriate generic explanations to undercut other generic explanations.¹³

Though the causes in each case are individuating and serve to distinguish a particular phenomenon in contrast with others in the same class, they need not be peculiar to that phenomenon alone and are often used outside of the class. So, for example, though the sea is the only kind of water to contain oil, and oil explains its flammability, oil can also explain the flammability of other things besides seawater. So too, the principles of reflection, useful in distinguishing the Aegean from Pontus, apply to rainbows and many other things besides. In fact, none of the causes is peculiar in an absolute sense, though sometimes the solution draws on something very close to being essential, e.g., heaviness of seawater (23.20). The individuating causes need only differentiate the phenomenon within its contrast set and this is the reason why a contrast is so often provided.

The generality of the causes in *Problems* 23 becomes evident when we contrast it with what we find in Aristotle's *Meteorologica*. Aristotle makes constant use of his special meteorological principles, the dry and wet exhalations, throughout the *Meteorologica* to explain the full range of phenomena. These exhalations, however, are restricted to the *Meteorologica* and with a few exceptions are found nowhere else. We find no such special principles among the solutions in the *Problems*. To be sure, we find theoretical principles—pores, for example—but these are of a very general nature and explain many other features of matter. There is no attempt, therefore, to separate the study of the sea, or even meteorology, as an autonomous and separate subject matter, and the criterion for admission into the book is only that the sea (or water) must somehow figure in the problem.

A final introductory word about the causes. Though it is often difficult to determine the exact identity of a cause, the vast majority of the identifiable causes in *Problems* 23 concern the nature of the physical materials and their

13 PA 2.12.657a20 of seals' ear passages; 4.8.684a34–b1 of lobsters' claws. A further example without reference to deformation will clarify the concept sufficiently. The lack of the upper eyelid in some birds and in the oviparous quadrupeds is explained by their having hard skin (PA 2.13.657a25–b18). That is, they share with viviparous quadrupeds, which have the upper eyelid, the need to protect their soft eyes, and it would be good for them to have upper eyelids like the viviparous quadrupeds, but the hard skin prevents this. Viviparous quadrupeds, then, are the norm; oviparous quadrupeds are the deviation.

motions. Qualities such as hot and cold, stickiness, and the nature of the visual ray play very much a secondary role.

Among the material causes, some deal with size and shape: the bulk of a body of water accounts for the nature of the waves and its ability to buoy up a ship (1; 3; 24; cf. 16); the size of particles of earth on the shore accounts for their ability to remain where they are and form a hard, smooth surface (29); the presence of pores accounts for seawater's greater transparency and its ability to dissolve salt (8; 15; 22). Other material causes deal with density, particularly of seawater (7; 13; 20; 31; 37), but also of air (6). Others again deal with composition and mixture (earth 7, 10, 25, 26, 32, cf. 13; sediment 6, 8, 38; oil 7, 9, 15, 32; bubbles 4).

Of moving causes, we find various forms of translation: bare motion (5; 31; 33; 36; 41; calmness 9); continuous pushing (2; 11; 12; 28); filtration (19; 21; 37); eddies (4; 5). Only one of these is really remarkable as a cause (others will be considered in the context of problems they are intended to solve): the tendency for a large bulk of something to have a disproportionately large effect. Aristotle had used it to explain the appearance of mock suns (*Meteorologica* 3.6.377b18–23; cf. *Problems* 15.6.91b20–25). It is used in *Problems* 23 to explain how the large bulk of water on the open sea raises a ship higher than does the small amount of water in a harbor (3) and why waves are smaller in a smaller body of water (1 = 24). It is applied to light (23) to explain why the Black Sea appears white—the visual ray reflects *en masse* from the water to the white mist.

Qualities and qualitative changes play a smaller role. Chief among these are heat and cold (9; 16; 27; 34; 39); stickiness (26; 40); viscosity (14; cf. 20); transparency and reflection and their effect on the visual ray (6; 23); and evaporation, surprisingly underrepresented (30; 34).

It is clear from this brief survey that the majority of the causes are of a mechanical nature and are easily applicable to subject matters other than the sea. In the remainder of this paper, I shall examine five sets of particularly interesting “little problems” both for the methodological issues they raise and in their own right for what they can contribute to our understanding of the ancient conception of the sea. This, then, is an investigation of the secondary nature of the sea, the nature that does not contribute to the grand scheme.

2 The Oily Sea

We begin with a set of problems that involve flammability and the heat of the sea, the strangest of which asks why seawater burns. It is so strange, in fact, that one wonders whether it is a problem in search of a solution, or a solution

(oiliness) in search of a problem (flammability).¹⁴ The question is posed at 23.32:

Why does the sea alone of waters burn (Διὰ τί ἡ θάλαττα μόνον τῶν ὑδάτων κάεται), whereas fresh water and river water do not? Is it because it contains a lot of earth? The salt proves this. Or is it because it is oily. The oil forming on salt proves this?

So far it seems that seawater is capable of burning. But at 23.15 the question is posed again, and the fact is immediately cast into doubt: “or does [water] too burn, whereas the sea is less able to extinguish fire because it is oilier?” Are we to understand now that (fresh) water is more flammable than saline? Probably not. Water’s flammability probably refers to basic elemental transformation. But are we really to suppose that seawater is less able to extinguish flames? Perhaps “not extinguishing flames” is another way of saying that seawater retains heat more easily.¹⁵ Indeed, Aristotle himself is flexible in his use of *κάειν* in the *Meteorologica* and the word does not always imply flame.¹⁶ This interpretation might gain further justification by the relative warmth of the sea in the winter. But though it would save us from the bizarre implications, in view of the fact that the contrast in 23.32 is with fresh water which obviously also retains heat, the interpretation is hard to sustain. Similarly if 23.15 only means that seawater is warmer than freshwater, we must wonder why the problem does not just say so, as 23.7 does.

We can get further clues about the nature of the phenomenon from the causes that are offered. Three causes are considered:

1. Passages (πόροι) in the seawater are less able to adjust to fire (15).
2. Salt is oily (15, 32).
3. Salt is earthy (32).

The first solution seems most amenable to “not extinguishing flames,” though the solution itself needs clarification. It has been attributed to Strato, according

14 The flammability of seawater is not borne out in experiment at a recent dinner party with professorial colleagues. Using Pacific Ocean seawater, candles were slowly doused with fresh tap water, ocean water, and 80 proof Vodka. There was no discernible difference in the ability of fresh and salt water to extinguish a candle. 80 proof Vodka, though, displayed a different behavior, causing the flame to sputter and spark.

15 In fact, the specific heat of seawater is lower than that of fresh. Cf. *Pr.* 23.7.

16 Wilson (2013, 69–70).

to whom heat passes through pores in matter.¹⁷ This accounts for the fact that things absorb and transfer heat.¹⁸ The controversial “fragment,” 56 Wehrli, provides information on how heat can or cannot penetrate a material. Fire, for example, is too thick to pass into diamond, and for this reason diamond cannot be heated.¹⁹ The implication is that the pores in the diamond are too narrow. The situation in our *Problems* 23.15, however, is not so straightforward. Here the pores cannot accommodate (ἀρμόττειν) the fire, because the *pores* are too thick, all the more so because salt is present.²⁰ The parallel passage that Flashar cites (Plutarch *Aet. Phys.* 913D) represents the entering *particles* as too thick to get into the pores. But here it is the *pores* that are too thick.²¹ How are we to understand this?

This solution may be clarified by consideration of *Problems* 23.22 and 8. Problem 23.22 asks why seawater is better able to dissolve salt than is freshwater. The reason is that the dissolved salt in the salt water consists of thick, i.e., big, particles, and these have the force to break up the solid salt. Again, bigger and more numerous pores in salt water account for the easier passage of light and so the greater transparency of seawater than fresh (23.8). Just as the interstices between large boulders are themselves large, so here both the particles and the passages between them are thick. Though this hardly contributes to the formation of the kind of straight passages necessary for transparency, nevertheless the relationship between big particles and big pores is clear enough.

With these passages in mind, we should probably suppose that the seawater pores do not fit the fire, i.e., the water pores are either too big or too small for the fire. The other passages just mentioned make clear that saltwater has big pores. If that is so, salt water does not extinguish the flame, because fire just goes through it. This interpretation fits well with the doubt that began 23.15—all water can undergo elemental transformation into fire, but seawater in a more specific way is less able to extinguish fire. The difficulty with this

17 So Flashar (1962, 653–54).

18 See Strato 30A Sharples and Keyser (2011, 307).

19 Fr. 56 Wehrli derives from Hero's description of pores. Sharples omits this from his collection, because Hero does not mention Strato by name. Berryman (2011) has convincingly argued against attributing Hero's introduction to Strato.

20 We have no evidence for ἀρμόττειν in Strato, unless we accept Hero *Pneum.* 1. proem.67: “The particles of air are in contact with each other, yet they do not fit closely in every part (οὐ κατὰ πᾶν μέρος ἐφαρμόζει), but void spaces are left between them, as in the sand on the sea shore” (Greenwood-Berryman trans.). See also discussion, Berryman (2011, 286).

21 LSJ does not give a sense of παχύς that corresponds to what is required here. Keyser 2011 argues the παχύ in the sense of “viscous” is a Stratonian element—a tantalizing connection, but it is still not clear how a pore can be παχύς in this sense.

interpretation is that our problem immediately goes on to draw a comparison with dry things: “therefore just as what is dry is less able to extinguish than what is moist, and what is dry is proportionally more able to burn (καυστικόν), the one is more so than the other, what is drier being more akin to the hot.” This is not a description of the impassivity of the dry, but of its ability to be hot or even its combustibility. Are we to suppose instead that the fire passes through the pores and as it does it breaks up the seawater? Undoubtedly combustion must do some such thing. If so, we should suppose that the fire passes through and breaks up, i.e., burns, the water as it goes. But 23.15 draws a distinction between seawater burning and its inability to extinguish fire, a distinction clear enough to assure us that 23.15 is not concerned with flames but that 23.32 is. It is not clear what pores are meant to explain.

The effects of oil in seawater strongly recommend flammability. Strange as the notion of oily, flammable seawater is, the problem was clearly understood in this way by ancient authors. So Plutarch cites *Problems* explicitly and says, “that the sea is oily Aristotle himself has said. For salt contains fat, so making lamps burn better” (*Quaest. conv.* 1.9 [*Mor.* 627C–D]), and again, “the sea helps fire to take hold and we warn people against throwing seawater on flames” (*Aet. Phys.* 911E; Clement trans.). Cassius Dio claims that during the battle of Actium the small quantities of seawater used to douse the flames on ships only caused the flames to burn the more, for “if they had used great quantities of it at once, they would somehow stop the fire by main force . . . they only increased the flames, since salt water poured on a fire in small quantities makes it burn vigorously” (50.34; Cary trans.). Though no one suggests that seawater can be simply set on fire, these passages clearly describe the accelerant nature of seawater and not just its ability to retain or transfer heat.

The connection between the flammability of the sea and its oiliness is made both in our *Problems* passages (15 and 32) and again in Plutarch (*Quaest. Conv.* 1.9 [*Mor.* 627C–D]) in the explicit citation of Aristotle. But the oiliness of salt is more widely attested than seawater’s flammability, and is probably the “fact” from which the problems arose.²² [Aristotle] *De mirabilibus* 134 notes that the salt in Libya, when dug up, is not hard but like very sticky gum (γλισχροτάτω γλοιῷ), and Pliny discusses the “flower of salt,” a kind of salt rust brought down by the Nile (here obviously in a fresh water context) which sometimes floats on springs; it yields an oily fat, “for there is, surprising as it may seem, a fat even

22 Pacific seawater, when set out to evaporate developed a slimy film, which coagulated into filaments, similar to, but more delicate than, egg whites in boiling water. As evaporation proceeded to crystal formation, the residue could be pressed between the fingers to produce a slippery liquid. Attempts to ignite it were unsuccessful.

in salt.”²³ Pliny treats the presence of oil in salt as surprising, and therefore not common knowledge.

As we expand the inquiry beyond burning, we may turn to *Problems* 23.7, which asks why the sea is warmer than fresh water. One of the three solutions here involves oil, where it is the mere presence of oil that is sufficient to make the sea warm in contrast with 23.15 and 32, where its flammability was in question.²⁴

The connection between heat, salinity, and fresh water is seen again in a rather different and perhaps not entirely consistent way in 23.18 where salt water, when heated and then cooled again, becomes fresh. A later parallel comes from Plutarch: “or is the salty flavoring extinguished in fruits by the action of heat, just as men remove saltiness from sea-water by boiling it?”²⁵ Cassius *Problemata* 64 provides a closer parallel and adds that in rendering it fresh one should boil the seawater down to a third its original volume. He adduces as the cause the fact that the fire breaks up the large particles in the water that make it salty.

Finally, a related problem (23.10) asks why, when one bathes in the sea, one dries off faster than when one bathes in fresh water, even though seawater is heavier than fresh. The formulation of the question is intended to be paradoxical, but the paradox is a clue to the solution—seawater is heavier, because it has more earth, and so having less moisture it dries more quickly. So the general cause, earthiness, has opposing valences. The effect is mentioned but also denied in the debate in *Quaest. Conviv.* 1.9 (*Mor.* 627B–F), where the briny scum remains unevaporated.

The method of the *Problems* as we have seen so far is to identify the basic nature of seawater, here its earthiness or saltiness or the size of its pores, and refer properties to those essential features. As causes these features are very general and explain many other things besides the properties of seawater. Since the causes are more general than the phenomena, the distinction between *explanandum* and *explanans* is maintained, that is, the kinds of things that

23 *NH* 31.90 Jones trans. Cf. *NH* 24.25 for bituminous oil skimmed off brine water in Zakynthos, Babylon, Apollonia and Agrigentum; cf. 31.109 for an oil in soda. Cf. Theophrastus *De aquis* 214A for a substance like olive-oil collected from a Carthaginian spring and used for sheep and cattle; and 214B for the Nile being sometimes salty; Dioscorides *Mat. Med.* 5.129. Partington (1960, 4) on various oil-water associations.

24 It is interesting that the lower freezing point of seawater is not mentioned.

25 *Aet. Phys.* 913C. The Loeb translation (Sandbach) understands the process as identical with what is being described here. Cf. *Pr.* 24.16 of the hot springs in Magnesia and Atarneus that are fresh.

form explanations do not become *explananda*. Pores, heaviness, earthiness, all serve as principles but never as properties. Also the problems seem to presuppose an implicit general outlook or theory, for example, that seawater is heavier than fresh, that it contains salt, or that fluids penetrate nearby earth. As we have seen, some problems are paradoxical, but paradox per se is not the goal, rather the problem setters are gathering problems that are not covered by the appropriately general theory. The particular explanations do not contradict these more general theories and expectations, that is, the explanations given are not ad hoc, and therefore can provide insights into various details of various theories. Whether these theories are all mutually consistent is another matter.

3 Flowing Seawater

Problems 23.20 asks why salt water is not free-flowing (ἀπόρρυστον), and this is tantamount to asking, “why are rivers not saline?” Many of the assumptions underlying this problem can be uncovered through a comparison with Aristotle’s theory of the sea (*Meteorologica* 2.1–3). For Aristotle it is the sea, not salt water per se, that is not free-flowing. The sea is a residue which settles and remains in the lowest hollows of the earth. Granted, one sea may flow into another, and water may flow through sea-straits, but these movements are different in kind from the flow of rivers. Again, Aristotle does his best to ignore salt springs, which give rise to saline rivers. He also goes to great lengths to separate the cycle of living, fresh water from the stationary residue of the sea. Seawater does not flow, not because it is saline, but because it is a residue, and this fact is for Aristotle part of the basic structure of the sublunary world.²⁶

In *Problems* 23.20, by contrast, in a subtle but important shift it is *salt* water that does not flow because it is salty, and salt springs play an important role. This problem shows how asking a question in a different way—changing the subject from sea to saltwater—changes the expected answer. Fundamentally, this problem concerns the viscosity of saline water, rather than its tendency to flow or not flow in rivers, and the viscosity is the result of its weight. If salt is the ultimate cause, we must say how salt water does sometimes move, and this is brought about by undercutting its saltiness either (1) by heating, (2) by filtering, or (3) by agitation. According to the first, saltwater cannot flow because it is heavy, but heated salt-water (hot springs) has the necessary lightness to

26 Wilson (2013, 179–95).

flow. According to the second, when the salt is filtered out of the seawater, as it frequently is by the shore, it can flow. According to the third, salty water, when moved and agitated, becomes sweeter. For this last cause we can compare Theophrastus (214A FHS&G): “running waters, and those from a conduit, are on the whole better than those that are stationary, and being dashed about they become softer.” In all cases the heaviness of salinity is undone by actually making it lighter, and both heating (at least 23.18) and agitation renders the saltwater sweeter.

In this way the issue of flowing and residue that had been basic to Aristotle’s analysis and central to his cosmic conception becomes the result of incidental changes. There is no consideration in this chapter of the possibility that it is only fresh water that is evaporated and generates the rain that feeds the rivers.

4 Winds, Waves, and Swells

Next we turn to a group of problems (2, 11, 12, 28) that consider waves as a sign of future winds. It is perhaps an unfamiliar notion, since we are most sensitive to waves that persist after a wind has subsided. This set of problems attempts to explain the nature of wind waves (waves produced by winds) and swells (the waves that are propagated outside of the region of the wind’s “fetch”). Unsurprisingly, swells are treated as a variation of wind waves. That winds cause waves is treated as unproblematic here as it was for Aristotle (*Mete.* 2.8.368a29–30). Aristotle too was aware of the phenomenal difference between wind waves and swell. *Problems* goes beyond him, however, by offering causes.²⁷

Our set of problems probably has its origin in Theophrastus *De ventis* 35, which is explicitly interested in prognostications, and it is probably for that reason that our problems are so formulated. However, what for Theophrastus was a prognostic is for the *Problems* a paradox. Since wind is the evident cause of waves, the presence of waves in the absence of wind is strange and unexpected. What we have then, is not the specification or the undermining of a general cause, but the compensation for its absence.

Theophrastus’ theory is the most ambitious. He provides an explanation for (1) why waves appear before the wind comes, (2) why waves persist after the

27 *Mete.* 2.8.367b12–19: “when the sea runs high the breakers are large and uneven, but when there is a calm, they are fine and straight. The wind produces the same effects on the cloud in the sky as the sea on the shore, so that when there is calm the clouds that are left are all straight and fine like breakers in the air” (Lee trans.).

winds subside, and (3) why waves display periodicity. He treats as unproblematic the notion that waves are thrust forward:

προωθείται δὲ <οὐ> συνεχῶς ἀλλὰ κατὰ μικρόν. τοῦτο δὲ προωθεί ἄλλο, ὃ προέωσε· καὶ πάλιν <ὃ προέωσε δι'> ἄλλης πνοῆς ἐκινήθη, μαρανθείσης τῆς πρώτης· εἴθ' οὕτως αἰὲ προωθούμενης προσέρχεται. παρόντος δὲ τοῦ κινουμένου φανερόν ὅτι καὶ τὸ κινοῦν ἥξει. (Coutant-Eichlaub)

They [winds? waves?] are pushed forward at intervals, not uninterruptedly; one pushes the other, which pushes a third; in turn, as the first dies, the next is pushed by another breeze. Thus then they come on as they are pushed forward. When that which is being moved appears, it is clear that the moving force will arrive. (modified Coutant-Eichlaub)

De ventis 35 clearly intends to explain why waves sometimes arrive before the winds that move them. Our text is the core of that explanation, and any successful interpretation must make that clear. Moreover, the chapter clearly states that waves persist after winds die, and this implies that waves can move by their own impulse and do not need to be constantly pushed along. Our text, however, is by no means secure and it will be best to work through the difficulties with one eye on the parallel passages in the *Problems*. *Problems* 23.11 provides the clearest parallel to Theophrastus:

ἢ διὰ τὸ αἰὲ προωθείσθαι γίνεται; προωθεί δὲ οὐ συνεχές πῶς ὃν τὸ πνεῦμα, ἀλλὰ ἀρχόμενον. τὸ μὲν δὴ πρῶτον ὥσπερ προεμαράνθη, ἄλλο δὲ τοῦτο προέωσε καὶ ἄλλην πυκνότητα ἤγαγεν καὶ ἀπεμαράνθη. ὥστε δῆλον, ὅταν ἤδη τὸ προωθούμενον παρῇ, ὅτι ἥξει καὶ τὸ κινοῦν. (932b30–35)

Or is it because of their being repeatedly pushed forward? The wind pushes forward, though it is not yet continuous; rather it is [just] beginning. Now the first wind withered away first, but this [the first wind] pushed forward another [wind] and created another dense mass, and withered away. So that it is clear that whenever that which is pushed forward arrives, the mover will arrive as well. (My translation)

The many verbal parallels with *De ventis* 35 imply a close relationship. However, the meaning of this problem is hardly any clearer and indeed may reflect a preexisting corruption in the *De ventis* text. Its conclusion is most naturally interpreted to mean that the thing προωθούμενον is the wave, not the wind (i.e., whenever the wave is pushed forward, it is clear that the wind will arrive). But

this in turn would suggest that the *πυκνότης* in the previous sentence is the wave, and this is a curious expression for a wave—though not for a wind, since very word is used in *De ventis* 35 to describe the *ἄήρ*.

If we focus on the competition between the wind and the wave, we might suppose that the sequential puffs of wind are pushing a wave along in the same way a traveler pushes luggage forward in an airport check-in line. But this model is nowhere clearly in evidence in our texts and, more importantly, cannot explain why the wave shows up first (for the luggage and passenger arrive at the head of the line at the same time).

Another, more likely, possibility is that wave formation and propagation is not the issue; rather we have here an account of why the air moves more slowly. The problem merely assumes and does not discuss the speed of the wave through the water. As such, both *De ventis* 35 and *Problems* 23.11 are to be read in conjunction with *Problems* 23.2, where the author explains both why waves travel quickly through water and *why winds are slow*:

Is it because the first part of the sea, near the origin of the wind, being pushed, always produces the same effect on the adjoining part? So, since the sea is continuous, motion comes to every part of it as if by one continuous blow. Now this occurs in one time, with the result that the first and the last parts are moved simultaneously. But the air does not experience this, because it is not one continuous body, through receiving from every direction many checks, which often hinder the first and most vigorous motion; but (these checks) do not do this to the sea, because it is heavier and harder to move than the air. (Mayhew translation)

Here the wind has a specific source, but it is being constantly buffeted by contrary winds. The sea, by contrast, forms a continuous mass, and is being treated as if it were something solid, a rod of iron as it were, which when moved at one end immediately translates the motion to the other end. Its heaviness and continuity contribute to the greater speed with which it is able to transfer the motion of the wave from one portion of water to the next. Since the air is not one continuous body, it seems that portions of wind are independently moving through a medium. These portions may either thwart one another's motion or push one another along. Eventually perhaps one large portion will form the kind of continuous stream of air we associate with a breeze. Of course, this model is an odd description of wave motion on the sea, not least because the translation of motion is not instantaneous as is the case with the iron rod. No doubt the sea is thought to be more elastic. It is, however, a clear attempt to explain the difference between wind and wave motion and their partial

independence, while at the same time provide an account of the greater speed of waves.

Problems 23.11 and *De ventis* 35 are best understood in conjunction with this passage. At the end of *De ventis* 35 Theophrastus says that the waves persist after the winds die, and this is hardly consistent with the airport luggage model. The discrete puffs of wind instead serve a double duty: they explain the pulsing nature of a set of waves and so constitute a general theory of wave formation; at the same time, since the puffs of wind dissipate and only slowly convey their motion, they explain why we see waves before there is any wind. This double duty leaves unanswered the question why when the wind is continuous (and surely it is sometimes) waves come one after another.

As mentioned above, this interpretation must confront the difficult final sentence in both 23.11 and *De ventis* 35: when that which is moved is present, it is clear that the mover will arrive. This is difficult to interpret as anything but the wind catching up to the wave. However, it is perhaps least difficult to suppose that though the speed of the wave has not been discussed since the statement of the thesis, it is reintroduced here as necessary to the conclusion. On this interpretation the argument of *De ventis* 35 could be paraphrased as follows: the waves on the sea are a sign of wind to come. Now it is obvious from the periodic form of waves that the winds that generate them are not continuous, but push them along puff by puff. But the first wind [sets the first wave in motion, and that wave continues in motion until it reaches us. That first wind, however, also] pushes another wind and again withers. But the other wind is moved then the first withers, and then in this manner the wind arrives with the wind having been pushed forward. And when the wave [which has been moving with a continuous motion since its first impulse] reaches us, it is clear that that which moves it will arrive.²⁸

28 Robert Mayhew has helped me a great deal with the text. There are two major lacunae, the first of 11 letters, the second of 8 letters. Mayhew's transcription of *Vaticanus gr.* 1302 (on which all other manuscripts of *De ventis* depend) is as follows:

προωθείταις <11 letters> δὲ συνεχῶς ἀλλὰ κατὰ
μικρόν· τοῦτο δὲ προωθεί ἀλλ' ὃ προῶσε καὶ πάλιν
<8 letters> ἄλλης πνοῆς ἐκινήθη μαρανθείσης τῆς
πρώτης· εἴθ' οὕτως αἰεὶ προωθουμένης προσέρ-
χεται· παρόντος δὲ τοῦ κειμένου φανερόν ὅτι καὶ
τὸ κινεῖν ἤξει·

By relying on *Problems* 23.11 and the interpretation above, I would emend the text in something like the following way:

On this interpretation *Problems* 23.2 provides us insight into the *difference* between wind and wave motion in a way that Theophrastus does not, and makes clear why waves travel quickly through water. In the end this theory is a variation of one that goes back to Plato. The puff of air pushes some water A, then subsides; water A rises and pushes some neighboring water B. Water A subsides, but water B now pushes water C, which in turns rises as a wave.²⁹ Of course, in our problem “one water” will end up being reduced by infinitesimal division into a continuous process.

5 Buoyancy

We would expect buoyancy to be explained simply by relative weight. After all, Aristotle knows that seawater is heavy and fresh water is light, and that therefore salt water sinks (*Mete.* 2.2.355a33–35). Though the *Problems* takes for granted that seawater is heavier than fresh, it investigates situations in which other factors besides weight account for buoyancy.

Water on the surface of the sea is saltier, in spite of its being heavier, because the lighter parts of the liquid have evaporated (23.30). Evaporation is used here on a rare occasion in *Problems* 23. It is a generic, background principle, used to explain saltiness in the first place, and used again here to explain a peculiar feature of seawater.

Two other explanations of buoyancy are offered. In *Problems* 23.3 the great mass of water in the open sea is able to raise a vessel higher than in the confined space of a harbor. There is no suggestion here that harbors may contain more fresh water. Instead we have an application of the widespread notion that a large mass is able to create an effect in violation of the rule of proportionality—size itself confers the power to buoy up. A further cause emerges in 23.13 and 26–27, where weight, though a partial explanation of buoyancy, does

προωθεῖ γὰρ <τὸ πνεῦμα, οὐ> δὲ συνεχῶς ἀλλὰ κατὰ μικρόν· τοῦτο δὲ πρῶτον ἄλλο προῶσε καὶ πάλιν <ἐμαράνθη.> ἀλλή δὲ πνοὴ ἐκινήθη μαρανθείσης τῆς πρώτης· εἴθ' οὕτως αἰεὶ προωθουμένης προσέρχεται. παρόντος δὲ τοῦ κινουμένου φανερόν ὅτι καὶ τὸ κινοῦν ἔξει.

I suggest that much of the corruption began as a result of Theophrastus not having made explicit the comparison between the wind's slow and the wave's rapid motion.

29 This is a common explanation in Plato (*Tim.* 59a; 79b–e; 80c); so also Aristotle *Physics* 4.8.215a15; 8.10.266b27–267a12. Cf. *De audibilibus* 803b29: as one bit of air moves another it makes the whole sound alike both in the case of high and low pitch. For the frequency of the blow keeps the sounds like their source. Of course, in our problem “one water” will end up being reduced by infinitesimal division into a continuous process.

not seem to be the whole story. 23.13 distinguishes different buoyancies in salt and fresh water in virtue of the earthiness of the salt water. But it is not the heaviness of the salt, it is viscosity (παχύτερον) that allows the swimmer to be supported (ἀντερείδειν) on top of it (a principle used also in explaining why salt water does not flow 23.20). Again in the explanation why salt water rests upon sweet wine (23.26) though salt water is heavy, our author suggests that either sweet wine has more earth (and is therefore more solid), or that it is heavier and more sticky (γλισχρότερος) thereby preventing the salt water, poured on top, from mixing with it. Though in this case it is the sweet wine that is supporting the salt water rather than the other way around, the principle is similar.

6 Visual Properties

A half-dozen problems deal with the visual properties of the sea, specifically its transparency and color. These problems are important because, like those concerning waves, they introduce innovations in the Aristotelian tradition. But, they also allow us to make further methodological observations, particularly about the form in which problems are cast and the application of explanatory principles from one problem to another.

Starting from the most general and proceeding to the most specific, four kinds of problems deal with transparency and color:

1. Water appears less white when moved (23, 41).
2. Seawater is more transparent than freshwater (8, 38).
3. Northern seas are more transparent than southern seas (9).
4. Seawater in Pontus is whiter than seawater in the Aegean (6).

Though the first set of problems is the most general, it will be best to postpone our consideration of it until we have dealt with the others. I shall begin instead with the second group (8 and 38), which wrestles with the paradox, “why is the sea more transparent than freshwater, although it is denser?” (8). This set of problems is especially interesting, because it engages with methodological issues addressed at the beginning of the paper.

Problems are usually posed in such a way that their subjects form the “marked” case—it is the *subject* that requires explanation. Thus problems 23.8 and 38 first ask what makes *seawater* more transparent. But they are unusual in considering the possibility that the explanation actually lies in the contrasting

case, the opacity of the *fresh*.³⁰ 23.38 makes this point explicit by considering the possibility that seawater only *appears* to be more transparent, whereas in fact freshwater, because of its sediment, is *less* transparent. This tendency to privilege the subject is well attested, and it demonstrates some of the weaknesses of the problematic method. For the form of the problem prejudices the enquirer toward supposing that there must be some feature peculiar to the *subject* that makes it that way. Nor is it a regular feature of the method to consider both subject and contrast case, and that is because, as I have argued, the contrast cases are often based on general truths already presupposed and perhaps proven in treatises.

Now, this leads us to the issue of the overuse of explanatory principles. If we look to freshwater as the cause of the sea's greater transparency, the reason lies in the earthy sediment, which is present in (flowing) freshwater and makes it turbid. Earthiness of water is a cause frequently used elsewhere, usually in relation to salt (7, 10, 13, 25, 26, 32). Here it is used in an extended way, but it is used effectively.

By contrast, if we look to the sea itself as the cause of its own greater transparency, we find much less effective explanations. The transparency may arise because the pores in the seawater are bigger and more numerous, and for this reason afford an easier passage for the visual ray (8); alternatively seawater may be oilier and therefore more transparent (38). In either case it is in virtue of some special addition that seawater has greater transparency. But neither of the causes, though used for other purposes in the book, is very satisfactory in this context, and this is probably why the author turned to the contrast case for a more satisfactory explanation. Since I have already considered the problems with the pore theory above, I need only repeat that larger particles and larger pores cannot facilitate transparency. If the oiliness of the sea is the cause, other difficulties arise. First, our author treats the explanation itself as problematic, on the grounds that oil is not more transparent than water and could therefore hardly make water more transparent.³¹ The train of thought seems to be this:

30 23.16 "why doesn't the wind blow cold from the sea in the morning, but it does from the river?" Perhaps it is the sea which is spread out; but perhaps that is not the cause, but rather the river is especially cold; so also 23.34: why does frost increase when lakes dry up? It is either because of the lake or the surrounding land.

31 *Pr.* 23.38.935b18–22: "Oil poured on to water makes it more transparent. And having oil in it, [the sea] is naturally more transparent. Or is not everything that is lighter also more transparent? For oil itself is lighter than water, but is not more transparent."

though oil in its own right is not more transparent than water, it makes water lighter, and what is lighter is more transparent; for this reason oil is the cause of the greater transparency. But such an explanation would hardly address the initial paradox, since the fact remains that seawater even with its oil is heavier than fresh.

Given the difficulties here, we may reasonably conclude that it is not because of its transparency that oiliness found its first application to the properties of seawater. The most likely first application is to the heat of the sea (23.7), as we have seen. We see here, then, competing tendencies in problem solving. The desire to account for many properties by the same principles—whether for economy or because of laziness—is countered by the inability of the subject to bear such repeated applications and strained extensions.

The “oily” cause is applied yet again to the third, more specific kind of problem in a way that likewise gets itself into a tangle. Oiliness was used as a cause of the transparency of seawater in general, as we just saw. Now the differences in this oiliness account for the greater transparency of northern sea over southern seas (23.9). In this problem no other cause is considered, and neither north nor south is especially “marked.” In the calm, warm waters of the south, the oil floats to the surface, where its relative opacity blocks the visual rays. In the cold of the north, by contrast, it remains inseparably mixed with the water and so renders the water more transparent. This explanation faces difficulties already raised in 23.38, where we found that oil, though less transparent than water, nevertheless makes water more transparent. Here oil straightforwardly makes water *less* transparent, but if all its blocking capacity is on the surface, the oil will render the water more opaque than if it is mixed in. This explanation is at odds with 23.23 and 41 where calm water is more, rather than less, transparent.

Finally, the last kind of problem should be treated together with the first, since both introduce ambiguities in the concept of white (λευκόν). 23.23 and 41 consider why water appears less white when moved. 23.6 considers why Pontus is whiter than the Aegean. These problems move us into questions of the Aristotelian theory of light, color, and reflection, and we need first to see the tension between the terms of the theories.

At first glance the vocabulary of color is not consistently maintained among the problems. Thus 23.41 contrasts the white (λευκόν) of the calm sea with the dark (μέλαν) of the choppy sea. In this context “white” just means “transparent” (διαφανόμενον; cf. 23 τὸ διαφανές λευκόν), whereas “black” just means “opaque.”³² In 23.6, however, Pontus is whiter (λευκοτέρων) because it has a lot of fresh

32 The non-transparency of black is a notion that goes back to Aristotle (*DA* 2.7); so also *Sens.* 3.439b17–18, where the analogy between light and shade, white and black is explicitly

water in it (and therefore a lot of sediment), and in 23.8 the sea is more transparent (εὐδιόπτερα) than fresh water. The combination of these two problems makes clear that white here is associated with the opacity of freshwater. White therefore means “transparent” in Problem 41 and “opaque” in Problems 6 and 8.

Flashar had argued that *De coloribus* 1 is the source for problem 23.23 and that Aristotle himself provides the background for 23.6.³³ A more careful review of the evidence, however, suggests that 23.23 depends on Aristotle and 23.6 does not.

Both 23.23 and 6 make use of the visual ray, a theory clearly attested in Aristotle. But 23.23 alone uses it an Aristotelian way (*De coloribus* uses the light ray).³⁴ This problem is especially remarkable because, though the question is straightforward, “why does water appear less white, if it is set in motion?” and we expect a simple binary contrast between calm and rough water, we get a second contrast between the short and the long distance that the visual ray has to travel. This second contrast is deeply embedded in Aristotle’s discussion of reflective phenomena in *Mete.* 3.2–6 and especially in 3.6, where distance has a weakening and darkening effect on the visual ray. So here, when the visual ray has a long way to go (πóρρωθεν), the calm sea can act as a smooth mirror and reflect the visual ray *en masse* (ἀθρόον) to the *light* above it. This makes the sea appear white, just as the mock sun appears as a white reflection of the sun in a patch of dense, smooth mist (*Mete.* 3.6.377b17–22). When, by contrast, the visual ray is short, it can pass through the transparent sea without darkening, and for this reason the sea appears white, by which our author here means bright and transparent. 23.23 compares this brightness with the darkness of the visual ray attendant upon its traveling a long distance through the air. This effect can be compared to the darkening of the visual ray as it goes through smoke (*Mete.* 1.5.342b10–11). All this is orthodox Aristotelianism.

In 23.6, however, the same basic principles are applied in an unAristotelian way. In explaining why Pontus appears whiter than the Aegean, our author changes and extends Aristotelian principles. 23.6 has the visual ray reflecting from the surface of the sea to the white ἀήρ above it.³⁵ According to Aristotle,

drawn: “the same conditions which in air produce light and darkness in bodies produce white and black.”

33 For discussions of *De coloribus* and color theory, see Halm (1978), Struycken (2003), and Sorabji (2004).

34 Similarity in the diction has led to positing a close relation between 23.23 and *De coloribus* 1. As Flashar notes: ὅταν τραχύνθῃ, καθάπερ ἡ τῆς θαλάττης φρίκη (*Col.* 791a21) = ἐὰν κινῆται, οἶον καὶ ἡ φρίκη.

35 If we can assume Forster’s emendations. See Flashar (1962, 652).

however, the reflection of a cloud in water appears as a rainbow rather than as white (3.6.377a31–b4; cf. 3.4.374b24–28). And there is nothing in Aristotle to correspond to the reflection to the clear sky of the Aegean. Similarly, the second solution in 23.6 for the greater whiteness of Pontus invokes the greater salinity of the Aegean, a factor that Aristotle had never considered. It apparently draws on the fact that seawater is more transparent than fresh, and that freshwater tends to reflect. Since Pontus has more fresh water on top, it appears white because the visual ray reflects to the ἄήρ. The more saline water of the Aegean is not as smooth (a principle again without precedence in Aristotle) and less reflective than the fresh. Consequently the visual ray penetrates the saline Aegean and in its depths weakens and fails, resulting in darkness. In these ways Aristotelian principles of optics are modified and adapted to new circumstances.

7 Concluding Remarks

It will be useful to sum up the major methodological observations scattered throughout the preceding discussion. The “little problems” that we find in book 23 suggest that they are the residue of a more general treatise on the sea. This treatise may be similar in scope to Aristotle’s *Meteorologica* 2.1–3, but cannot be the same—certainly many of the solutions of book 23 are patently unAristotelian. The apparently paradoxical nature of many of the problems arises from the way they are cast against our more general expectations about the sea. Indeed the way a problem is cast has enormous influence on how it is answered, and the contrast cases against which a problem is set can direct an enquirer inappropriately. In addition to the presence of certain background assumptions like the greater density of seawater, we observed the strong tendency to identify a standard answer, especially oiliness, which used once with success, gets extended to remoter and more implausible applications. It remains to consider the extent to which these methods are pursued in other books of the *Problems*.

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Problemata 26 and Theophrastus' *De ventis*: A Preliminary Comparison

Robert Mayhew

It has long been recognized, and is beyond doubt, that there is a connection between *Pr.* 26 and Theophrastus' *De ventis*. The first scholar I know of who made explicit his awareness of this connection is the unknown 'second hand' writing in the margins of *Bernensis gr.* 402 (ca. 1480), a manuscript which includes *De ventis* (fols. 42r–53v).¹ Over a dozen times he quotes the *Problemata* in the margins, adjacent to the passage in *De ventis* it parallels. What is more, he makes it clear that he accepts the ancient attribution of the *Problemata* to Aristotle; for in the margin next to the words τὸ δὲ μὴ πνεῖν κατὰ ταύτην τὴν Αἰγυπτῶν (the opening line of what is ch. 8, according to the modern divisions in *De ventis*), he writes: ταῦτ' οὗτο καὶ ἀριστοτέλης ἐν προβλήμασιν (fol. 43v), a reference to *Pr.* 26.44.² I assume he believed *Pr.* 26 was prior to *De ventis*. Now the view that these two works are related, and that *Pr.* 26 was written by Aristotle and thus precedes *De ventis*, is found in the earliest commentaries on *De ventis*—Bonaventura (1593) and Furlanus (1605)—and it persisted into the 19th century among scholars working on this Theophrastan treatise: see, for example, Schneider (1818–21).³

In the 20th century the situation changed radically, owing to a change in how scholars viewed the *Problemata*, namely as a work that is not (at all or for the most part) by Aristotle, but by more than one Peripatetic, working perhaps centuries after Aristotle. From this perspective, *De ventis* should (likely) be considered a *source* for the parallel passages in *Pr.* 26—the latter is raising questions about the former—and not the other way around. This is the view, for example, of Forster (1921, 1927, 1933), Flashar (1962), Steinmetz (1964),

1 On the second hand in *Bernensis gr.* 402, see Burnikel (1974, 25–34). The date of the second hand is likely not long after 1480, and certainly before the publication of the Aldine edition (1497). I should note that there are twelve manuscripts of *De ventis*, and *Vaticanus gr.* 1302 (circa 1300) is the ultimate source of the other eleven (see Burnikel 1974, 90).

2 More on the connection between *Pr.* 26.44 and *Vent.* 8 shortly.

3 Barthélemy-Saint Hilaire, however, in his translation with commentary of the *Problemata*, is non-committal. For example, speaking of the relationship between *Pr.* 26.3 and *Vent.* 50, he writes: "Il est évident que l'un des deux passages a été emprunté à l'autre" (1891, 2: 226).

and Coutant & Eichenlaub (1975).⁴ For most of these scholars, the relationship between *De ventis* and *Pr.* 26 is non-complex and obvious—that is, *De ventis* simply is prior to *Pr.* 26, and this priority can be assumed with little or no argument.⁵ For example, Steinmetz discusses the relationship between *Pr.* 25–26 and *De ventis* in a section of his work entitled *Die Nachwirkung der theophrastischen Windlehre* (1964, 60–68), and there assumes the priority of *De ventis*.⁶

Until recently, this is how I viewed the relationship between *Pr.* 26 and the *De ventis* (see Mayhew 2011, 2: 156). What I want to do in this chapter is re-examine what has become the standard view.

1 A Critical Analysis of Pierre Louis's Thesis

Pierre Louis, in the *Notice* to Book 26 in his Budé edition of the *Problemata* (1993, 194–99),⁷ argues for a view of the relationship between *Pr.* 26 and *De ventis* that represents a rejection of the standard modern view and a return to the older one.⁸ In what follows, I present his arguments in detail, and while doing so offer my criticisms of them. I do not criticize Louis simply because I think his arguments fail; more importantly, by going through his arguments and responding to them, I hope to underscore the difficulties involved in establishing with certainty the precise relationship between some section of the *Problemata* and a text with parallel passages. The results should have implications beyond the relationship between *Pr.* 26 and *De ventis*.⁹

4 For example, Forster presents *Vent.* 19–20 alongside a parallel passage in *Pr.* 26.48, and simply comments: “the compiler of the latter clearly copies from the former” (1921, 166). Ruelle et al. (1922), Hett (1937), and Ferrini (2002) all note parallels between the two works, but say nothing about which has priority. This is not to say that any of them is in fact non-committal.

5 Flashar (1962) is an exception, in or to the extent that he sees the relationship as complex. For although he claims that *De ventis* “ist die Hauptquelle für *Prob.* xxvi,” he adds: “Während in den meisten Fällen die Priorität Theophrasts sicher ist, scheint in einigen Fällen Theophrast von den *Prob.* abhängig zu sein” (673).

6 For more on Steinmetz's view of the relationship between *Pr.* 26 and *De ventis*, see note 23.

7 Unless otherwise indicated, quotes from and references to Louis are from or refer to this *Notice*, and thus bibliographical information (including pagination) is not indicated.

8 I say *represents* a rejection and return, because Louis does not in fact refer to the view he is supplanting nor to the fact that he is defending an interpretation that had once been widespread. He simply states and defends his position.

9 At the very least, this study should contribute to discussions of the relationship between *Pr.* 2 and Theophrastus' *De sudore*, and between *Pr.* 5 and his *De lassitudine*.

After describing the contents of *Pr.* 26, Louis notes that much of it is found almost verbatim (“presque textuellement”) in *De ventis*. He then turns to cataloging the parallels between the two texts, using a number of different formulations to describe the similarities (or degree of similarity) between passages: e.g., “correspond aux,” “ont plusieurs formules en commun,” “une parenté certaine,” “grande similitude,” “traite le même sujet.” I have no complaint about these claims.¹⁰ Such similarities, he correctly concludes, cannot be a coincidence: “Des telles rencontres ne peuvent être fortuites. L’un des deux auteurs s’est manifestement inspiré de l’autre et l’a même parfois servilement copié.” But who slavishly copied off of whom? The answer, Louis thinks, is clear:

La comparaison des textes permet d’affirmer avec une quasi-certitude que c’est Théophraste l’imitateur, sinon le plagiaire. C’est lui presque à coup sûr qui a utilisé dans ses études sur les vents des indications que lui fournissait la section xxvi, comme il s’est servi également, mais dans une moindre mesure, des *Météorologiques*. Deux passages au moins de son traité *Des Vents* en fournissent la preuve.¹¹

Let us look at these sets of passages—and what they are supposed to prove—in turn.

The first pair is *Pr.* 26.48 and *Vent.* 19: “Le premier se trouve dans le chapitre 19: Théophraste s’étonne que l’on puisse se demander « pourquoi les vents sont froids alors qu’ils sont dus au mouvement du chaud ». L’allusion à la section xxvi est évidente: car c’est précisément la question qui est posée dans le problème 48.” Louis’s argument is straightforward: *Pr.* 26.48 asks a question, and in

¹⁰ By my count, 25 of the 62 chapters of *De ventis* are comparable to chapters in *Problemata*; and, 43 of the 63 chapters of *Pr.* 26 are comparable to chapters in *De ventis*. (Although the final chapter in *Pr.* 26 is no. 62, there are 63 in total because—like most editors and translators of the *Problemata*—I divide ch. 35 in two: 35a and 35b.) For a useful concordance listing the parallels between the *Problemata*, the *De ventis*, and [Thphr.] *De signis*, see Becchi (2013, 96–97). (Note that Becchi 2013 was published—or in any case came to my attention—only after I completed the penultimate draft of my essay, and so I do not discuss its claims in detail, though I do refer to it in three other footnotes.)

¹¹ Cf. Becchi (2013, 97): “A mio avviso queste concordanze, per quanto significative, non suffragano nessuna delle due ipotesi, anche se non escludono la dipendenza di entrambi se non da una fonte unica almeno da una o più fonti comuni. La tendenza poi quale traspare dal *De ventis* a riorganizzare, razionalizzare e integrare il materiale aristotelico avvalorare l’ipotesi che i *Problemata* siano stati una della fonti, anche se non l’unica, a cui Teofrasto ha avuto accesso.” I believe I make a case, in what follows, for rejecting this account.

Vent. 19 Theophrastus expresses surprise that anyone could ask that question; therefore, Theophrastus is replying to (and so posterior to) *Pr.* 26.48.

If we compare the actual texts, however, we see that the direction of influence is not as clear as Louis suggests. It is enough to quote the opening line of each text:

Pr. 26.48: Why are the winds cold (τὰ πνεύματα ψυχρά ἐστίν), though they come from the movement of heat (ἀπὸ τῆς τοῦ θερμοῦ συγκινήσεως)?

Vent. 19: If some people wonder, thinking it irrational (ἄλογον), that the winds are cold coming from the motion and generally from the heat of the sun (ἀπὸ τῆς τοῦ ἡλίου κινήσεως καὶ ἀπλῶς τοῦ θερμοῦ), what appears irrational to them is deceptive.¹²

Louis could be right: Theophrastus could be responding to *Pr.* 26.48. But I find equally plausible the idea that (1) the author of *Pr.* 26.48 is raising, in the standard form of a *problema*, a question about what Theophrastus says, or (2) both Theophrastus and the author of *Pr.* 26.48 are independently, and in different ways, referring to a puzzling meteorological *endoxon* that was discussed in the Lyceum. And these do not exhaust the possibilities.

The second set of passages is *Pr.* 26.44 and *Vent.* 8 (and 61).

Le second passage me paraît tout aussi probant. Dans le chapitre 8 du traité *Des Vents*, Théophraste qualifie de faux les propos de «certaines gens qui dissent que le vent du sud ne souffle pas en Egypte». Il a certainement en vue le problème 44 de la section XXVI qui commence par les mots: «Pourquoi le vent du sud ne souffle-t-il pas en Egypte?»

Again, Louis's argument is straightforward: *Pr.* 26.44 asks a question, and in *Vent.* 8 Theophrastus points out that the main assumption underlying that question is in fact false; therefore, Theophrastus is replying to (and so posterior to) *Pr.* 26.44. And the same can be said for *Vent.* 61: "La même critique est reprise par Théophraste avec la même netteté dans le chapitre 61 du même traité."

12 Translations are my own. Those of the *Problemata* come from Mayhew (2011). Text and translation of the *De ventis* are drawn from my work in progress on a critical edition, with translation and commentary, of that treatise for Project Theophrastus (to be published by Brill).

Once again, if we compare the texts we see that the direction of influence is not as obvious as Louis maintains. I quote only the relevant portion of each text:

Pr. 26.44: Why does the Notos not blow in Egypt itself in the regions by the sea nor for the distance of a night and day run [inland] (ὅσον ἡμέρας δρόμον καὶ νυκτός), whereas in the regions beyond Memphis and extending for the distance of a night and day run, it is vigorous (λαμπρός)?

Vent. 8: That the Notos does not blow in Egypt itself into the sea, as some say, nor extending for the distance of a night and day run [inland], but in the regions beyond Memphis it is vigorous (λαμπρόν), and likewise too in those places which extend to such a distance, they say this is not true but false. In fact, it does not blow as much [there], but less.

Vent. 61: That the Notos does not blow vigorous (λαμπρόν) in Egypt extending for the distance of a night and day run [inland], is false.

Again, Louis could be right: Theophrastus could be responding to *Pr.* 26.44, in order to reject the assumption behind the question with which it opens. And in fact I do think this argument of his has a bit more force than the previous one—it is a stronger *hypothesis*—in that Theophrastus, in the remainder of *Vent.* 8, refutes the main assumption underlying that question with an argument not referred to in *Pr.* 26.44:

And the reason (αἴτιον) is that Egypt in its lower regions is hollow, so that [the Notos] passes over it, but its upper regions are higher, since indeed proximity requires magnitude (ἐπεὶ τό γε σύνεγγυς ἀπαιτεῖ τὸ μέγεθος).¹³ For one must explain such [phenomena], which are according to nature, especially with reference to their locations. . . .

Nevertheless, it remains distinctly possible that (1) both Theophrastus and the author of *Pr.* 26.44 are independently, and in different ways or from different perspectives, referring or responding to a meteorological *endoxon* or (2) the author of *Pr.* 26.44 is raising a question about what Theophrastus says—either

13 I assume Theophrastus is saying that winds require greater power the closer they are to or when they are in contact with higher elevations.

for some pedagogical purpose or because he has doubts about Theophrastus' rejection of this particular *endoxon*.¹⁴

Now, as Louis believes it has been established that *Pr.* 26 is prior to *De ventis*, it should be clear who the best candidate is for its authorship: Aristotle himself. This book, he claims, is simply a set of notes edited by Aristotle.¹⁵ But one could just as well conclude, not that Theophrastus is the imitator or plagiarist of Aristotle, but that—at least in the case of some of the verbatim passages (not where the two works seem to be at odds with each other)—Theophrastus is in fact the author of both. Louis does not consider this possibility; and this is likely because he believes the parallels between *Pr.* 26 and Aristotle's *Meteorologica* support the Aristotelian authorship of *Pr.* 26.¹⁶ He refers the reader to the notes to his translation, where he indicates such parallels, though he focuses on a half-dozen pairs of passages.¹⁷ Not only do these passages confirm Aristotelian authorship, in his view, they furthermore “supposent indubitablement l'antériorité de cette partie des *Problèmes* par rapport aux *Météorologiques*”! For example, Louis argues that because *Pr.* 26.1.940a32 and *Mete.* 2.6.364b19 are related but also contradict each other, we should conclude that the error in the former was rectified in the latter, and so the former was written before the latter.

But this entire line of reasoning is faulty. There is no reason to assume, as Louis does, that if a passage in the *Problemata* contradicts a passage in or position held by Aristotle or Theophrastus, the *Problemata* passage must be prior to the Aristotelian or Theophrastan passage that it contradicts (with the latter correcting the former). This is important to keep in mind, as such contradictions are not that infrequent. For instance, *Pr.* 4.15 opens as follows:

14 I find entirely unconvincing Louis's appeal to terminology here:

“Dans les deux cas [i.e. *Vent.* 8 & 61] il emploie pour qualifier un vent violent l'adjectif *λαμπρός*. Or ce mot se trouve également dans le problème 44 de la section XXVI. Comme d'autres particularités de vocabulaire sont communes aux deux ouvrages, on est en droit de conclure que l'utilisation de *λαμπρός* par Théophraste n'est pas un effet du hasard. S'il en est ainsi l'antériorité de la section XXVI sur le traité de Théophraste ne semble pas devoir faire de doute.”

At most he has shown that the appearance of *λαμπρός* in *De ventis* and in *Pr.* 26 is not a coincidence; but we can infer nothing from this about the priority of either work.

15 Cf. Becchi (2013, 96): “la sezione XXVI . . . dei *Problemata* aristotelici o ps.-aristotelici”.

16 Though not as numerous as those between *Pr.* 26 and *De ventis*, there are indeed connections with the discussion of wind in the *Meteorology*—at least ten such instances.

17 *Pr.* 26.13 and *Mete.* 2.5.361b30–35; 26.18 and 2.8.367b20–31; 26.1.940a32 and 2.6.364b19; 26.2 and 2.5.362a11; 26.34.944a28 and 2.2.354b33–35a32; 26.36 and 1.13.349a26–b19.

Why is having sex the most pleasant activity, and is it so for animals out of necessity or for the sake of something? Is it pleasant either because the seed comes from the entire body, as some claim, or indeed it does not come from the entire body, but through that region into which all the pores of the veins extend?

This passage reveals an openness to the Hippocratic “pangenesis” theory according to which seed is drawn from the entire body—a view Aristotle critiques and rejects in *GA* 1.17–18. So according to Louis’s logic, we should conclude that *Pr.* 4 was written prior to the *De generatione animalium*—but no scholar (including Louis) has come to such an implausible conclusion.¹⁸

According to Louis, the text that most of all proves the priority of *Pr.* 26 to Aristotle’s *Meteorologica*, is this passage from the latter (2.6.363a21–25):

Let us now speak about the position of the winds, and which ones are opposite to which, and which can blow simultaneously and which cannot, and what sort and how many there happen to be, and in addition to these about any other conditions that have not been discussed in the particular *Problems* (ἐν τοῖς προβλήμασιν . . . τοῖς κατὰ μέρος).

This would seem to refer to *Pr.* 26, and it suggests to Louis that Aristotle himself was its author; but such confidence is unwarranted, or at least requires further argumentation.

There are a number of references in the *corpus Aristotelicum* to a work by Aristotle with the title *Problemata* (in some form), but at least six of these references cannot be traced to anything in the extant *Problemata*.¹⁹ Further, there are nearly fifty references in other ancient works to a *Problemata* by Aristotle (see frs. 711–12, 721–68 Gigon), most of them in Plutarch, Galen, Apollonius (the paradoxographer), and Aulus Gellius. And though many of these can be traced to the extant *Problemata*, most of them cannot. This has led some scholars²⁰ to distinguish two separate works: the (lost) *Problemata* of Aristotle, and the extant *Problemata*, which was written by someone else. I have elsewhere (Mayhew 2011, 1: xx–xxi) suggested an alternative explanation for these ancient references:

18 See Louis (1991, 75–79). Here I can do no more than assert that it is implausible.

19 The six are: *Somn.* 2.456a24–29, *Juv.* 5.470a15–18, *PA* 3.15.676a19–21, *GA* 2.8.747a34–b6, *GA* 4.4.772b6–12, *GA* 4.7.775b25–776a8.

20 E.g. Flashar (1962, 303–16).

But it seems on the face of it odd that some of the *Problems*-references in Aristotle would refer to his own (now lost) *Problems*, and others to the extant work. This lends support to a second possibility: The *Problems* began as a work by Aristotle—who authored some chapters and perhaps directed the authorship of others—and over the years, and beyond his death, some material was added to this work, and other material was removed or otherwise lost. On this interpretation, all of the ancient references are to the same work, but not all of that work survives.

Whichever of these two views is correct, Aristotle's reference in the *Meteorologica* to a discussion of wind in the *Problemata* is not enough to prove or confirm that *Pr.* 26 was written or compiled prior to the *Meteorologica*. For one could argue that this reference points to a discussion of wind in the lost *Problemata*, or (as I believe is likely correct) that *Pr.* 26 contains some original Aristotelian material, but that some of the original material was lost and other material was added later (and which is which is usually difficult or impossible to determine).

Perhaps Louis's weakest argument concerns the geographical locations mentioned in *Pr.* 26—the weakness exacerbated by his remarks about its probative value: “ce témoignage, qui me paraît irréfutable.” Louis argues that the references to Attica (26.17 & 56), to Lesbos (56), and to Mt. Athos (36—“cette montagne n'est pas loin de Stagire”) support Aristotelian authorship, as Aristotle lived near all three places at one time or another. But the inclusion of such place-names is at best suggestive; and in fact, this presentation of the evidence is highly selective. Here are the other locations mentioned in *Pr.* 26: Libya (16 & 49), Egypt (44), the Atlantic Ocean (52), Cyrene (56), “the islands” (56), Hellespont (56), and Arcadia (58). This list covers a broad range of places, and taken as a whole compels us neither to accept nor deny Aristotelian authorship. Moreover, there is a great deal of evidence that the author(s) of *Pr.* 26 relied on reports about winds and were not in every case speaking first hand. Proverbs and other interesting claims about the winds are a special concern of some chapters in this book.²¹ The reference to Mt. Athos in *Pr.* 26.36,

21 *Pr.* 26: 9 (“Why is it said/do they say [λέγεται]: ‘The Boreas [blows] not at night once the third daylight has come?’”); 20 (“And this is why they have the proverb [παροιμιάζονται]: ‘When the Notos begins and when the Boreas comes to an end’ ”); 27 (“And this is why the proverb [παροιμία] refers to it: ‘when the Notos begins’ ”); 29 (“Why does the Caecias alone of the winds bring the clouds to itself, as the proverb says, ‘Drawing to himself like Caecias does a cloud?’”); 41 (“Why is it said: ‘When the Notos begins and when the Boreas comes to an end?’”); 45 (“Why is the Notos slight when it begins, but becomes stronger when it

cited by Louis, provides an example of this: “Further, on very high mountains there are no winds, for instance on Mount Athos and other such places. There is a sign (σημείον) of this; for what those who sacrifice in a previous year leave behind, they say (φασι) is found to be still there in the next year” (944b13–15). This feature of *Pr.* 26 undercuts the place-names as evidence for authorship. Finally, the vast majority of chapters do not mention any specific location, and those that do are almost exclusively in the last third of the book—and half of these locations are mentioned in one chapter (56). So even as an hypothesis about Aristotelian authorship based on these place-names, this would have to be limited to very few chapters.

Louis concludes his *Notice* to *Pr.* 26 with a last piece of evidence in support of his case for Aristotelian authorship. He writes that “L’attribution de la section xxvi à Aristote ne semble pas avoir fait de doute dans l’Antiquité,” and then cites this reference to the *Problemata* in the *Noctes Atticae* of Aulus Gellius (2nd c. AD):

This too has been observed by the most experienced philosophers of nature, that when the south winds blow the sea becomes bright and blue, [when] the north winds [blow the sea becomes] dimmer and blacker. I noted the cause of this when making excerpts from Aristotle’s books of problems (*Aristotelis libros problematorum*). (2.30.11)

This is clearly a reference to what has come down to us as *Pr.* 26.37.²² But that Aulus Gellius thought the *Problemata* was by Aristotle is of course no guarantee that the attribution is correct.

Based on this critical review, I conclude that Louis does not come close to making the case for the priority of *Pr.* 26 to *De ventis* or for its Aristotelian authorship. In fact, he has not even demonstrated that this is a reasonable hypothesis. A review of his arguments, however, was enough to convince me that the opposite view—what has become the standard one—is not

comes to an end, whereas the Boreas is the opposite, and this is why the proverb says ‘It is good to sail when the Notos begins and when the Boreas comes to an end?’”; 46 (“Why is it said: ‘If the Notos summons a Boreas, winter comes forthwith?’”); 57 (“Why is it said: ‘Do not fear a cloud from the mainland in winter but from the open sea, and in summer from the dark mainland?’”)

22 *Pr.* 26.37 is brief enough to quote in its entirety: “Why does the sea become blue when the Notos [i.e. south wind] blows, but dark when the Boreas [i.e. north wind] blows? Is it because the Boreas disturbs the sea less, and anything that is more undisturbed appears black?”

self-evidently correct. That is, I do not believe it is obvious that the *De ventis* is prior to *Pr.* 26, and so we should not assume it is without further argumentation based on a detailed analysis and comparison of the two works. In the next section of this essay, I take a first step in the right direction by making a further comparison.²³

2 The Zephyr in *Pr.* 26 and *De ventis*

I have already examined three parallels considered important by Louis in defending his thesis: *Pr.* 26.48 and *Vent.* 19; 26.44 and *Vent.* 8; and, 26.44 and *Vent.* 61. I argued that the first parallel does not support the priority of either text, while the other two offer mild (though in no way overwhelming or conclusive) support for the possible priority of *Pr.* 26. The parallel texts I turn to now—taken together—provide a great deal of support for the priority of *De ventis*.²⁴

In *Vent.* 37, there is a shift in focus to “the particular characteristics of each wind” (τὰ καθ’ ἑκάστων ἰδία), which are what they are, Theophrastus says, according to each wind’s “nature and position” (φύσιν καὶ θέσιν). A couple of lines later, he adds: “the most particular characteristics (ιδιώτατα), so to speak, are those concerning the Caecias and those concerning the Zephyr”—and it is clear in what follows (*Vent.* 38–45) that this is especially true of the Zephyr.²⁵

Vent. 38 lists a number of the particular characteristics of the Zephyr:

The Zephyr is smoothest of the winds; it blows in the afternoon and towards the land and cold, in only two seasons of the year, spring and autumn. But in some places it blows stormy, whence indeed the poet named it “ill-blowing,” whereas in some places it blows moderately and softly. And this is why Philoxenus rendered its current “sweet.” Although it nourishes some <crops>, others it kills and so differs completely.

23 Note that although Steinmetz (1964, 60–68) too conducted a comparison of parallel passages—specifically *Vent.* 6–9 and five chapters from *Pr.* 26 (19, 29, 38, 44, 62)—he never asks which is prior, but assumes the priority of Theophrastus. Rather, for Steinmetz the questions to ask are: How does the compiler or collector (*Der Sammler*) of *Pr.* 26 use the Theophrastan material? What material comes from Theophrastus despite *not* being taken verbatim from the *De ventis*? What material in *Pr.* 26 is “untheophrastisch” (or even “in diametralem Gegensatz zu Theophrast stehen”)? I do not deny that these are interesting questions.

24 Becchi (2013, 99–100) briefly discusses the Zephyr in *Pr.* 26.52 and *Vent.* 38 & 40–41.

25 The Zephyr is the west wind; the Caecias is (roughly) an east-by-northeast wind.

ὁ δὲ ζέφυρος λειότατος τῶν ἀνέμων καὶ πνεῖ δειλῆς²⁶ καὶ ἐπὶ τὴν γῆν καὶ ψυχρὸς, τῶν ἐνιαυσίων ἐν δυοῖν μόνον ὥραις ἑάρος καὶ μετοπώρου. πνεῖ δ' ἐνιαχοῦ μὲν χειμέριος, ὅθεν καὶ ὁ ποιητὴς δυσαῇ προσηγόρευσεν, ἐνιαχοῦ δὲ μετρίως καὶ μαλακῶς. διὸ καὶ Φιλόξενος ἡδεῖαν αὐτοῦ πεποίηκε τὴν πνοήν. τοὺς μὲν <καρπὸς> ἐκτρέπει, τοὺς δ' ἀπολλύει καὶ διαφέρει τελείως.²⁷

In *Vent.* 39 Theophrastus briefly mentions a particular characteristic of the Caecias, before turning to a sustained discussion of the characteristics of the Zephyr.

I here list the characteristics mentioned in each of the following chapters, omitting the explanations for them that Theophrastus in some cases provides: The Zephyr is cold (ψυχρὸς) (*Vent.* 40); it does not blow continuously (οὐ συνεχής) (40); it is even or steady (ὁμαλός) (41), it blows in the afternoon and stops at night (41); it “brings the greatest clouds” (ἄγει νεφέλας μεγίστας), and is stormy and ill-blowing (χειμέριος καὶ δυσαῆς) (42); “Its steadiness and smoothness . . . produce a certain delight” (ἡ ὁμαλότης καὶ λειότης . . . ποιεῖ τινὰ χάριν), which makes this wind pleasant (ἡδύς) (43); nevertheless, it “ruins some crops, but nourishes others” (τοὺς καρποὺς οὓς μὲν φθείρει οὓς δὲ τρέφει) (43). In *Vent.* 44–45, Theophrastus goes on to explain how the Zephyr itself differs depending on location—e.g. on whether it blows in Locris or Gortyna or Thessaly.

Of the 63 chapters in *Pr.* 26, the Zephyr is mentioned in ten of them (21, 22, 24, 27, 31, 33, 35a, 52, 54, 55). In three of these (21, 27, 54), the Zephyr is not the main topic—that is, a problem is not being raised about it in the opening question. None of these three has any connection to or parallels in *De ventis*. Six of the seven remaining chapters do (24, 31, 33, 35a, 52, 55),²⁸ however, and these will form the basis of the comparison with *Vent.* 38–45.

26 *Vaticanus gr.* 1302 has δειλῶς (‘cowardly’), which one might try to interpret as ‘timidly’—but that’s a stretch and in any case would be redundant with λειότατος. There are two emendations worth considering, as each fits the context well, improves the sense of the line, and involves a change of only one letter: The Aldine edition prints δεινῶς (‘terribly’), Bonaventura (1593, 172–73) suggests δειλῆς (‘in the afternoon’). Given what Theophrastus goes on to say about the Zephyr, δεινῶς is not impossible. But Bonaventura is right that *Vent.* 41 and *Pr.* 26.35a both support δειλῆς. *Vent.* 41: τῆς δειλῆς ἡ πνοή (“the blowing is in the afternoon”); *Pr.* 26.35a.944a31: Διὰ τί ὁ ζέφυρος τῆς δειλῆς πνεῖ; (“Why does the Zephyr blow in the afternoon?”).

27 This line in the manuscripts reads τοῖς μὲν ἐκτρέπει, τοῖς δ' ἀποκλείει καὶ διαφέρει τελείως. It has been emended by most editors. I offer one possibility here. See my forthcoming commentary *ad loc.*

28 The exception is *Pr.* 26.22, which is brief enough to quote in full: “Why do dogs find the scent least when a Zephyr is blowing? Is it that the Zephyr is most confusing because, of

I begin with *Pr.* 26.31, which raises a general question about the positive qualities of the Zephyr. There is virtually no explanation of these characteristics in *De ventis*, as most attention is given to why this normally pleasant wind can also be stormy and destructive. In fact the only explanation provided is that the Zephyr is steady because it blows from over water and not out of the mountains (*Vent.* 40–41). For purposes of comparison, I here present only the relevant portion of *Pr.* 26.31. The author begins with a question about the Zephyr, followed by a provisional explanatory question and then further explanation, before turning to a contrast with other winds (which part I omit):

Why does the Zephyr seem to be gentle and the most pleasant of the winds, and for instance even Homer says [*Od.* 4.567] that in the Elysian Field “always the breezes of the Zephyr are blowing”? Is it foremost because it contains a mixture of air? For it is neither hot like the winds from the south and the east, nor cold like those from the arctic, but it is on the border between the cold and the hot winds: being near both it shares in their capacities, and this is why it is temperate (εὐκρατός), and blows most in spring. (943b21–28)

This chapter provides an explanation for the pleasant and gentle nature of the Zephyr not found in *De ventis*. Now although it is possible that the relevant portions of *Vent.* 38–45 and *Pr.* 26.31 are not directly related, but each is separately referring to a common opinion or observation,²⁹ I think it more likely—given the close connection between *Pr.* 26 and *De ventis* generally—that *Pr.* 26.31 is raising a question about the positive characteristics mentioned in *Vent.* 38–45. But either way, it seems clear that *Pr.* 26.31 is *not* one of Theophrastus' sources for writing about the Zephyr, and so that Louis's thesis is wrong at least in this case.

I turn next to a comparison of *Pr.* 26.24 and the opening line of *Vent.* 42.³⁰

all the winds, it is the most continuous (τὸ συνεχέςτατος) and blows most on the land?” This chapter contradicts the claim in *Vent.* 40 that the Zephyr is not a continuous wind.

29 One might find support for this view in the fact that Theophrastus refers to the poet Philoxenus, whereas the author of *Pr.* 26.31 quotes Homer's *Odyssey*.

30 I limit myself to the opening line, because after describing in that line one characteristic of the Zephyr (the characteristic discussed in *Pr.* 26.24), Theophrastus moves on to other characteristics not discussed therein.

Pr. 26.24: Why, of the winds, does the Zephyr bring the largest clouds? Is it because it blows out of the ocean and over the sea? Therefore, it brings [them] together from out of a large [area].³¹

Vent. 42: And [the Zephyr] also brings the largest clouds, because it blows out of the ocean and over the sea, so that it brings [them] together from out of a large [area].³²

These two passages are nearly verbatim, so one is merely a copy of the other (unless they were both written by the same person or both copies of some third text). But considered out of context, if one is merely a copy of the other we cannot determine which is a copy of which.

The same is true if one compares the second half of *Vent.* 41 with *Pr.* 26.35a:

Vent. 41: The blowing [of the Zephyr] is in the afternoon (τῆς δείλης), because of the location. For all [winds] come with the sun dispersing or vaporizing the moisture or assisting in the origin (πάντα γὰρ μετὰ τοῦ ἡλίου διαχέοντος τὸ ὑγρὸν ἢ ἀτμίζοντος γίνεται ἢ συνεργούντος εἰς τὴν ἀρχήν). So when [the sun] reaches this location the blowing <begins>, and it stops during the night because the motion of the sun fails.

Pr. 35a: Why does the Zephyr blow in the afternoon (τῆς δείλης)? Or do all the winds come when the sun disperses the moisture (ἢ ἅπαντα τὰ πνεύματα τοῦ ἡλίου διαχέοντος τὸ ὑγρὸν γίνεται)? For when the power of the heat is near, it consumes [the moisture] that previously collected. Now the Zephyr blows from the west. So it is reasonable that it comes in the late afternoon; for then the sun reaches that location. (944a31–35)

Though not actually verbatim, the language in each passage is similar, and they both make fundamentally the same point. As in the previous case, considered out of context we cannot tell who copied off of whom (or whether they were both written by the same person, or whether they were both relying on some third text).

Pr. 26.33 is more expansive than ch. 35a, but treats the same characteristic of the Zephyr and essentially offers the same explanation for it:

31 Διὰ τί μεγίστας νεφέλας τῶν ἀνέμων ὁ ζέφυρος ἄγει; ἢ διότι ἐκ πελάγους πνεῖ καὶ κατὰ τὴν θάλατταν; ἐκ πολλοῦ οὖν καὶ συνάγει.

32 ἄγει δὲ καὶ νεφέλας μεγίστας, ὅτ' ἐκ πελάγους πνεῖ καὶ κατὰ θάλατταν, ὥστε ἐκ [προ]πολλοῦ συνάγειν.

Why does the Zephyr blow towards the afternoon, but not in the early morning? Is the sun rising and setting the cause of the winds in most cases? For when the sun, by thorough heating, concocts and dissolves the air, which is moist, it dissolves it into wind; and if the air is full of wind, it is still further made windy by the sun. So when the sun is in the east, it is far away from the Zephyr; for this blows from the setting sun. And when the sun is already close to setting, the wind is then thoroughly dissolved. But from midday and to late afternoon [the sun] is in the most suitable position with respect to heating and dissolving the air. (944a10–19)

It is difficult to make a secure case for either *Pr.* 26.33 expanding on material in *Vent.* 41, or *Vent.* 41 condensing material in 26.33.

I conclude with an examination of *Pr.* 26.52 (which I have divided into three parts to facilitate discussion):

[1] Why is the Zephyr both the mildest of the winds *and* cold, and why does it blow mostly in two seasons—spring and autumn—and towards evening, and mostly on land? [2] Is it cold because it blows from the sea and wide open plains? Now it is less cold than the Boreas because it blows from evaporated water and not from snow, but it *is* cold because it blows after winter, when the sun is just achieving mastery, and in autumn, when the sun no longer has mastery. For it does not await the sun's heat, as if it were on land, but it wanders because it has gone over water. [3] And it is steady for the same reason: for it does not blow from the mountains nor from what is melted by force, but flows easily as if through a channel. For the regions towards the north and south are mountainous; but towards the west there is neither mountain nor land, but the Atlantic Ocean, so that it travels in the direction of the land. And it blows towards evening because of the location [from which it comes]: for at that time the sun comes close to that location. And it stops at night because the movement from the sun ceases.

The opening question [1] reads like a survey of the characteristics of the Zephyr mentioned in *De ventis*; for the author asks why the Zephyr is the mildest (*Vent.* 38), is cold (40), blows mostly in spring and autumn (38), blows toward the evening (41), and blows mostly on land. This question is not followed by an explanation of each characteristic, however, but rather by more and less, i.e., [2] by an explanation of why the Zephyr is cold, and [3] by explanations of why it is steady—a characteristic not mentioned in the opening question—and why it blows toward the evening.

In fact, [2] is virtually identical to *Vent.* 40, and [3] is virtually identical to *Vent.* 41.

The most likely explanation for the patchwork, not-well-integrated, nature of *Pr.* 26.52 is that its (unknown) author crafted a general question about the characteristics of the Zephyr, culled from *Vent.* 38–41, and then offered as a (preliminary?) answer passages cut and pasted from *De ventis*. This makes infinitely more sense than to suppose that *Pr.* 26.52 was written first (by Aristotle!), and then taken over by Theophrastus to become (what are now called) *Vent.* 40–41.

I have examined parts of *Vent.* 38–45 and the parallel passages in *Pr.* 26 in relative isolation and in doing so have found virtually no support for Louis's view that *Pr.* 26 is prior to *De ventis*, and some support for the priority of *De ventis*. But I think the case against Louis is even stronger if we consider that *Vent.* 38–45 (excluding 39) is an extended and integrated discussion of the Zephyr, whereas the relevant passages in *Pr.* 26 are scattered and disorganized. Of the two possibilities—that Theophrastus, in writing this section of *De ventis*, relied upon and built on the parallel chapters in *Pr.* 26, or that these chapters in *Pr.* 26 are an accumulation (over time, and in no particular order) of questions and answers about the discussion of the Zephyr in *De ventis*—the latter is far more likely (to put it mildly).

Nevertheless, without knowing what purpose a given set of *problemata* serves—the reason for which it was written—we ought to exercise a great deal of caution in making claims about the authorship of a text or its precise relationship to another text to which it is obviously connected.³³ And we do not possess such knowledge. For all we know, *Pr.* 26 could be (a) a set of questions or criticisms raised about Theophrastus' *De ventis* and other Peripatetic works on meteorology, (b) pedagogical exercises for and/or by students in the Lyceum, (c) questions raised in the Lyceum about meteorological *endoxa*, (d) notes composed as a prelude to writing a treatise on winds, (e) all of the above, by several hands, accumulated in no particular order, over many decades (or more). I suspect (e) is most likely to be true. But without first establish-

33 This essay is in part a *mea culpa* statement; for in preparing the notes to my Loeb translation I did not exercise such caution, but referred constantly (and confidently) to the source(s) of some *Problemata*-chapter. Shortly after completing that work, however, I came to regret not using "Cf." or "See" in place of the more tendentious "Source." In the case of *Pr.* 26, this occurs in the following notes to my translation: 1, 6, 9, 10, 13–14, 16, 17, 20, 22–23, 25, 35, 37–39, 41, 44, 47–48, 51, 53–55, 57, 61–62, 64, 67, 79, 85, 86, 88, 92–93, 98–99, 103, 105–109, 111, 113, 117–18, 120. Regrettable word-choice notwithstanding, I trust that these notes remain useful references to texts that are in some way related.

ing which of these *Pr.* 26 in fact is (and that would likely require a detailed scholarly commentary, if it is possible at all), it is impossible to conclude with certainty much about its *precise* relationship to the *De ventis*.³⁴

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34 I presented some of my first thoughts on and questions about *Pr.* 26, and its connection to *De ventis* and other Peripatetic works on winds, at a workshop that I co-organized with the late Allan Gotthelf: "The Place of the *Problemata* in Aristotelian Natural Science" (University of Pittsburgh, May 2012). It was an extremely useful experience; but as I cannot remember which of my fellow participants gave me what feedback, I'll simply thank them all. In addition to Allan, they are: István Bodnár, Alan Bowen, Andrea Falcon, Jim Lennox, and Mariska Leunissen. I put the finishing touches on this essay during a 2013–14 sabbatical leave: I wish to thank Seton Hall University for granting me that leave, and the Ayn Rand Institute for a Research Grant that made possible a year-long sabbatical.

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On *Problemata* 27: Problems Connected with Fear and Courage

William W. Fortenbaugh

1 Structure and Content

Pr. 27 of the pseudo-Aristotelian *Φύσικα προβλήματα* (*Physical Problems*) is typical in that it divides into a series of chapters, eleven in all, each of which begins with a question introduced by διὰ τί: “on account of what” or simply “why.” In nine of the eleven chapters, an answer follows straightway. It, too, has the form of a question, being introduced by ἢ, ἢ ὅτι or ἢ διότι: “Is it that” or “Is it because.” The form is largely stylistic and may be construed as a tentative assertion/answer. In three chapters (2, 8 and 11) intermediate material comes between the question and the answer. The material is quite brief, serving only to clarify the problem at issue.¹

Pr. 27 carries the heading “Ὅσα περὶ φόβον καὶ ἀνδρείαν,” “Those [Problems] Which Concern Fear and Courage” or perhaps “As Many [Problems] As Concern Fear and Courage.” Either way, the relative ὅσα should be construed as dependent on the title *Φύσικα προβλήματα*. Put differently, Book 27 is announced as a collection of problems dealing with the physical and physiological aspects of fear and courage. That is a matter of some interest, for when taken together with the three books that follow—“Those [Problems] Which Concern Moderation and Licentiousness, Continence and Incontinence” (28), “Justice and Injustice” (29), “Prudence and Intelligence and Wisdom” (30)—it is tempting to say that *Pr.* 27 is one of four books which are, as it were, misfits in that their focus is on ethics and politics and not on physical and physiological problems. The idea is not foolish, and Book 29 on justice and injustice can be labeled a misfit in that it ignores physiology in favor of political issues. But the other three books are largely concerned with the physiological basis of virtue and vice. In regard to Book 27, the qualifier “largely” is important, for one of the eleven chapters, namely ch. 5, puts the question “Why do cities honor courage most of all, though it is not the best of the virtues?” and provides an

¹ On intermediate material, see Flashar (1962), 342, and above in my essay on *Pr.* 3 (p. 104). In *Pr.* 27 the intermediate material is twice introduced by γάρ (2.947b16, 11.949a9); once it simply asserts that the conditions referred to are contraries (8.948b13–14).

answer in terms of political expediency. That harmonizes poorly with the chapters that precede and follow, for those chapters are focused on physical and physiological issues. Had ch. 5 come last, it might be explained as an afterthought by a late compiler, who found no better place to add a left over scrap. But the chapter comes in the middle and interrupts the series of physiological problems.

Although ch. 5 is unique in being the sole chapter within *Pr.* 27 which is narrowly focused on an ethical-political issue, I do not want to overlook the fact that ch. 3 makes reference both to persons, i.e., soldiers being routed in battle (948a1, 6), and to brave persons who are equipped for battle and experience trembling (948a8–9). In a different context, being routed in battle might be turned into an issue of values (the good citizen holds his ground choosing to die for his country) and the trembling of a brave man might be contrasted with that of a coward (the latter being shameful), but it would be a stretch to claim that ch. 3 is focused on values. Rather, its primary concern is the physiological effects of anger and fright (947b23–948a7). Mention of war and courageous individuals comes only at the end of the chapter, where a physiological explanation is given of the trembling experienced by courageous soldiers, who whip themselves in order that they may be heated (948a7–12).

So, too, in ch. 4, mention is made of courage, but the focus is on physiology. The question posed is why the courageous are for the most part lovers of wine. The answer turns on recognizing that courageous individuals are hot and that wine is not only hot but also more effective in removing thirst than water, especially in courageous individuals. No consequence is drawn concerning either the habituation of future citizens or the consumption of wine prior to battle.² That may be disappointing, but for our purposes, it is enough to recognize that ch. 4 is like ch. 3 in its concern with physiology.

2 Repetitive Chapters 1, 6, and 7

Repetitive chapters, i.e., those putting the same question, are common in the *Physical Problems*.³ In *Pr.* 27, ch. 1, 6, and 7 are examples. Ch. 1 is the shortest

2 At the very end of ch. 4 we are told that those who have been drinking wine, i.e., those who are at least to some extent drunk (οἰνωμένοι) are more courageous than those who are not drunk (948a29–30). In a political-military context, we might expect the author to develop the idea by discussing wine as an antidote against the real and imagined terrors of battle (see 948a17–18), but he does not do so.

3 See Flashar (1962, 323–25); and for examples in *Pr.* 3, see above, pp. 104–10.

of the three; indeed, it is the shortest of the eleven chapters that make up Book 27. The question that introduces the chapter runs: Διὰ τί οἱ φοβούμενοι τρέμουσιν; “Why do those feeling fear tremble?” (947b11). A brief answer follows in the form of a question, “Is it because of the cooling?” The chapter ends by explaining the cooling and stating a consequence: “For the heat departs and is contracted, for which reason also the bowels are loosened in most people” (947b13–14). We may compare ch. 3, where we read that in persons feeling fear heat and blood flee together⁴ downwards, for which reason there is also a loosening of the bowels (947b27–29). Missing in ch. 3 is the qualifier “in most people” (τοῖς πολλοῖς) (1.947b14).⁵ The qualifier is not to be ignored, for it shows a certain sophistication of the part of the author. He understands that he is engaged in empirical science: more precisely, his subject is human physiology, in which observed correlations admit exceptions. In regard to fear, we can cite the occurrence of painful sensations due to changes within the body. Feeling pain is a recognized mark of fear (see 9.948b20), but there are occasions when frightened individuals experience no pain.⁶ If we think that such cases are unusual, we may want to say that pain occurs for the most part, thereby allowing for occasional exceptions.⁷ Similarly in regard to the bowels, we may want to say that there are cases in which the bowels are not loosened, but in most persons experiencing fright their bowels are loosened. Two comments are necessary.

First, we should not confuse bowels being loosened with actual defecation. It would be absurd to say that most people who feel fear actually experience a bowel movement. They do not. Rather, our text is saying that when people feel frightened, cooling occurs in the upper body and heat descends and that normally causes the bowels to relax. Actual defecation may or may not occur.

4 “Flee together” translates συμφευγόντων (947b28). The language of flight is repeated later in ch. 3 of blood (948a4) and elsewhere in *Pr.* 27 of the genitals (7.948b12) and of heat (10.948b37). This use of φεύγειν is hardly new: See Arist., *Resp.* 20, where the verb is used in regard to the downward flight of heat in persons feeling fear (479b22–24). Within the *Problems* in a book on fear, the metaphor seems appropriate and not entirely dead. Indeed, in ch. 10 it may be said to enliven the text, as the author explicitly likens the heat in us to an animal and speaks of it fleeing whatever it fears (10.948b36–37).

5 In ch. 1, the phrase τοῖς πολλοῖς (947b14) is masculine plural. It picks up οἱ φοβούμενοι in the initial question (947b12). Hence, the translation “in most *people*.”

6 For example, in sudden alarms a man might respond straightway without noticing anything that might be called a painful sensation. And when a frightened man is totally absorbed in deliberating how best to escape danger, he may experience nothing painful. For discussion, see Fortenbaugh (2002, 111–12) and (2011, 248).

7 Cf. Arist. *EE* 2.2.1220b13–14, on which see Fortenbaugh (2006, 97–98).

Ch. 10 is instructive. There we are told that when people experience fright, the heat within them moves downward. The regions around the bowels and bladder are warmed and relaxed (διαλύονται),⁸ which makes the organs ready to function (εὐτρεπεῖς) (948b38–949a2). Here we have distinguished a first stage, which applies to most individuals who feel frightened. There occurs internal warming, which is preparatory to defecation but does not necessarily result in actual defecation.

The second comment takes us to ch.8. There we read that the bowels of frightened individuals are loosened some of the time (ἐνίοτε) (948b18). As in ch. 10, the focus is on the departure of heat downward and the effect it has on the bowels. Only this time the effect seems more limited: αἱ δὲ κοιλίαι ἐνίοτε λύονται, “and the bowels are *sometimes* loosened.” Assuming that λύονται refers to heat induced relaxation, should we claim a significant departure from what is said in ch. 1? Perhaps, but we must remember that we are dealing with a physiology that is primitive at best and resistant to measurement. When people are frightened, they are typically concerned with external dangers and are unlikely to notice changes within. As a result, a statistical survey concerning changes in and around the bowels would be unreliable.

Ch. 7 is longer than ch. 1 and shorter than ch. 6. It begins with the same question as ch. 1: “Why do those feeling fear tremble . . . ?” (948b6). There is no variation in vocabulary or word order. Nevertheless, ch. 7 differs (as the ellipses indicate) in that the opening question continues with a list stating where trembling is most readily observed: καὶ μάλιστα τὴν φωνὴν καὶ τοῦ σώματος τὰς χεῖρας καὶ τὸ κάτω χεῖλος, “and especially in the voice and concerning the body, in the hands and the lower lip” (948b6–7).⁹ The answer that follows agrees with ch. 1 in referring to the departure of heat; the same phrase occurs in both chapters: ἐκλείπει τὸ θερμὸν (947b13, 948b8).¹⁰ Only the answer in ch. 7 is longer, for there the voice, hands and lower lip are all mentioned.

What comes next in ch. 7 has no parallel in either ch. 1 or ch. 6. If we adopt the text as transmitted, we are told first that persons who feel fear emit bile

8 The verb διαλύεσθαι is cognate with the simple form λύεσθαι. The prefix strengthens the simple form. Hence, Mayhew translates διαλύονται “thoroughly loosened” (949a1). If I have a worry, it is the use of the English verb “to loosen” for this suggests to me something stronger than relaxing, i.e., it suggests that defecation actually occurs.

9 The list divides in two: first comes the voice; second come two parts of the body: hands and the lower lip. We are not to infer that trembling in the voice is not tied to a particular part of the body. See 6.948a37–38.

10 The repetition of the phrase is noticeable but not peculiar to chs. 1 and 7. It is found twice in ch. 8: once with the verb in the indicative and once with the infinitive (948b15, 18). In ch. 6 the verb is replaced by the cognate noun (948a36–37).

and their genitals contract (948b10). Second we are told that there is emission on account of liquefaction resulting from descending heat and that retraction occurs because fear comes from outside, so that flight¹¹ is in the opposite direction (948b10–12). There is a difficulty here, namely, the mention of frightened persons emitting bile: καὶ προῖενται μὲν τὴν χολήν (948b10). In what follows, we read of persons experiencing emission due to concoction: προῖενται διὰ τὸ συντήκειν (948b10–11). The verb lacks a direct object, so that one is likely to understand χολήν.¹² But is that correct? I think not and refer to Septalius, who long ago noted the possibility of reading γονήν instead of χολήν (1632, 3: 312). To my knowledge, no recent editor or translator accepts Septalius' emendation, but the perceived corruption can be easily explained. At a time when scribes still copied manuscripts written in majuscule, a scribe (either working in haste or copying a poorly written manuscript or both) might misread a gamma as a chi and a nu as a lambda, so that γονήν became χολήν. Taken alone, that is little more than speculation; but we should not overlook ch. 11, which is closely related to the text that concerns us. There we find discussion of both the contraction of genitals and the emission of semen. The question posed is: "Why do persons feeling fear contract their genitals?" The subsequent discussion of contraction is like the text that concerns us in that the verb συσπᾶν occurs in both places (11.949a9, 13, 14, cf. 7.948b10). The verb ἀνασπᾶν does not occur, but the phrase συσπᾶται . . . ἄνω does (11.949a15–16, cf. 7.948b11). Moreover, we find a clear statement of fear causing the emission of semen. The verb προῖεσθαι does not occur but we have the cognate noun conjoined with γονή: i.e., we have the phrase ἡ τῆς γονῆς πρόεσις (11.949a19–20, cf. 7.948b10–11). In my judgment, that strongly supports reading γονήν instead of χολήν in ch. 7. A conservative philologist may still prefer to print the received text, but in that case I would recommend not only including γονήν in the critical apparatus but also adding a reference to the related phrase in ch. 11. And should there be a translation, I would recommend hanging a note off "bile" and not supplying "bile" after the second reference to emission as Forster does.

Ch. 6 is longer than ch. 1 and 7, but it is like them in that it puts the same question in the same words: Διὰ τί οἱ φοβούμενοι τρέμουσιν; "Why do those feeling fear tremble?" (948a35, cf. 947b11). It is like ch. 7 and unlike ch. 1 in that it goes on to specify the same three areas in which trembling occurs: the voice, the hands and the lower lip. Nevertheless, it differs from ch. 7 in that μάλιστα is placed before τρέμουσιν and καί is omitted after the verb and before the list of

11 Regarding "flight," φυγή (948b12), see above, n. 4.

12 In his translation, Forster (1927) supplies "bile" without indicating that it is not in the Greek text.

affected areas (948a35–36, cf. 948b6). That has the effect of uniting the list more closely to the question concerning trembling. The explanation of trembling given in ch. 6 is essentially the same as that in ch. 1 and 7—ἐκλειψίς . . . θερμοῦ ἐκ τῶν ἄνω τόπων, “a departure of heat from the upper region” (948a36–37, cf. 947a13 and 948b8). The rest of ch. 6 focuses on the loss of heat in the three areas already specified. A few details merit mention. Loss of heat from the upper parts is said to be the cause of becoming pale (948a36–37). That is not found in ch. 7.¹³ The departure of heat from the chest is cited to explain not only trembling in the voice but also trembling of the hands (948a37–39). That differs from ch. 7 in which the trembling of the hands is explained by the fact that hands are most easily moved and have the least blood within (948b9). Although different, the two explanations are not incompatible. Much the same can be said of the lower lip: as long as it is hot, it remains upright, but when heat is withdrawn it trembles (948a39–b3).

Ch. 6 ends with a remark concerning persons caught up in anger, ἐν τοῖς θυμοῖς (948b3–4).¹⁴ The lip no longer remains upright, it hangs down, because the heat goes to the heart (948b3–5), i.e., it has departed the chest (948a38–39). In a book referring to fear in its heading and in a chapter which begins with a question focused on persons feeling fear, a closing remark on anger may seem gratuitous; in a modern work it might be added in a footnote. Nevertheless, the remark is not to be condemned as an unrelated add-on, for it concerns the lower lip, which has been the subject of what precedes, and offers yet another explanation in terms of departed heat.

3 The Emission of Semen

In the preceding section, I argued that *Pr.* 27.7 associates fear with the emission of semen, not bile (948b10), and that ch. 11 makes a similar connection. Here I want to call attention to *Pr.* 4.7, which makes the same connection. It begins with the question: “Why is it that although having sex occurs on account of heat, and being afraid and dying produce cooling, [nevertheless] it happens to some people, when they are in these conditions, that seed (σπέρμα) issues forth?” A single answer is given: “Is it that when some places [in the body] are cooling others heat up, because they possess their proper heat and are receiv-

¹³ It is found in ch. 8 (948b17).

¹⁴ Θύμος used of anger is common. In *Pr.* 27, see ch. 3 where the opening question includes the phrase ἐν τοῖς θυμοῖς (947b23). Explicit references to anger follow (947b27, 39).

ing the heat of the places that are cooling down; hence, as these places cool down, [emission] happens not on account of the cooling, however, but on account of the heating?" (877a23–29). In what follows, we are told that this is clear from observation. Reference is made to defecation and urination caused by fright, and heat is said to move down in fright and upward in death. The heat causes moisture and makes seed (σπέρμα) issue forth (877a30–34). There is nothing here that contradicts what we read in *Pr.* 27. The proximate cause of emission is the hot and the moist, though in certain cases like fear and dying a fuller account will refer to cooling which leads to heating in the region of the groin. Moreover, the author of 4.7 is careful to add ἐνίοις . . . ἐν τούτοις πάθει, "to some people in these conditions" (877a24–25). The concentration of heat and moisture in the groin causes emission only in some cases.¹⁵

The use of πάθη in the phrase ἐν τούτοις πάθει is inclusive: It covers not only the emotion of fear but also the condition of dying. That may be obvious, but it is well to underline that fear is essentially a cognitive πάθος: it necessarily involves the thought of danger. In contrast, dying is a physiological process that is not tied to some particular thought. Of course, a person who is dying may be conscious and aware that he is dying. He may even engage others in conversation. A well-known example is Socrates, whose death is recorded by Plato in the *Phaedo*. We are told that Socrates, having drunk hemlock, admonished those in attendance to control their tears and walked about before lying down on his back. Cooling advanced from below: first the feet, then the legs, and then the groin. At this point Socrates enjoined Crito to sacrifice a cock to Asclepius. Crito replied that he would, and Socrates fell silent. Shortly thereafter Socrates moved and died. According to what had been said earlier by the man who administered the poison, the chilling effects of hemlock had reached the heart (117d–118a). As reported by Plato, Socrates did experience a mild emotion, annoyance or fault-finding, directed at those in attendance.¹⁶ But the thought that caused Socrates' annoyance, i.e., the thought that others were weeping aloud when silence was called for (117d–e), was not the cause of death. That was hemlock, which set off a physiological process that ended in death.

The fact that Socrates is reported to have lain down on his back might be thought to prepare the way for emission. For in Theophrastus' treatise *On Fatigue* 17, sleeping on one's back is said to be the position in which nocturnal

15 Cf. ἐνίοτε, "sometimes" in *Pr.* 27.8.948b18, on which see above p. 314.

16 On fault-finding as an emotion involving mild disapproval, see Fortenbaugh (2006, 95–98) and (2011, 250–53).

emission occurs (cf. *Pr.* 10.16 892b16–17).¹⁷ Moreover, the movement that Plato attributes to Socrates might be understood in terms of erection and ejaculation. Plato avoids an explicit mention of emission, because it would be out of place in a poignant scene of undeserved death.¹⁸ He does, however, provide a clue, when he tells us that Socrates moved (ἐκινήθη 118a). That strikes me as a stretch and of little relevance to the *Problems*. For in the pseudo-Aristotelian work emission is tied to heat and moisture. In the death scene of the *Phaedo*, cooling has already occurred in the area around the groin and was attacking the heart. Pushed to explain how we should interpret the motion Plato attributes to Socrates, my suggestion is that we should think of a final jerk or twist, a kind of relaxation, as the body shuts down in death. We should not assign Socrates to that unspecified number of persons (ἐνίοις, *Pr.* 4.7.877a24) who in death emit semen.¹⁹

In conclusion I want to call attention to *Pr.* 27.9, in which a contrast is drawn between fear and physical pain. Whereas people who feel pain hold their breath, which is subsequently released in a cry, people who feel fear remain silent; the heat within is carried downward, where it creates breath, which results in passing wind (948b20–26). The case of physical pain, receives further attention. We are told that all of who suffer pain, πάντες πάθοντες, make use of aids that are provided by nature, φύσει, and do so straightway and without deliberation, εὐθὺς . . . ἄνευ λογισμοῦ. In the case of physical pain, a person holds his breath and in this way collects within himself heat, which concocts the pain (948b35–949a8). Here we have a description of a physiological condition, pain, which causes a physiological response, which does not require reflection on the part of the affected individual. We are not given a parallel account concerning fear, but the following can be said. Fear is more than a physiological condition. It begins with/is caused by the thought of imminent danger, which not only results in bodily pain but also causes one to deliberate about how to avoid harm.²⁰ That is important, but it does not tell us why in some cases fear

17 See above, p. 114 on *Pr.* 3.

18 In the *Phaedo*, it is of dramatic importance that Plato has Socrates lie down on his back, for then the man who has brought the hemlock will be able to uncover Socrates' face and Crito will be able to close Socrates' mouth and eyes. To roll the body over to see Socrates' fixed eyes and open mouth would detract from the poignancy of the scene.

19 We might imagine that in Socrates' case the cooling associated with old age had removed the possibility of emission. That would give new meaning to the notion of living too long, but the idea is not to be pressed.

20 See Arist. *Rhet.* 2.5.1383a6–7 with Fortenbaugh (2002, 79–80).

is accompanied by the emission of semen. Should we take a cue from Freudian psychologists who think that overwhelming fear causes a person's inhibitions to break down so that repressed desires come to the fore and cause emission?²¹ Or should we stay focused on the *Problems* and say that that explanation is entirely physiological: the emission of semen occurs on account of concoction brought on by the removal of heat from above to the region of genitals? To be sure, cognition was in play: a frightened person thinks danger imminent and desires to escape; but if I understand the *Problems* correctly, it is the increase of the hot and the moist in the area of the groin, which is the proximate cause of emission.

Wearing my Peripatetic hat, I much prefer the latter explanation; at the same time, I want to acknowledge that it will not satisfy modern physiologists, who explain emission in terms of glands, nerves and muscles.²²

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21 Freudian psychologists recognize not only that fear and anxiety can block emission, but also that emission can occur despite such emotions. They offer an explanation in terms of displaced anxiety. Distracted by a present danger, the ego is unable to keep in check a preexisting sexual desire that had been deeply repressed. Emission follows. See, e.g., Feldman (1951, 528–49).

22 What we read in the *Problems* fails to prevent confusing emission attributable to fright with emission brought on by choking. The latter phenomenon is familiar to practitioners of autoeroticism and can explain cases of hanging in which emission occurs. A person standing on the gallows may be frightened of imminent death, but if the rope is short so that the fall is not great, he dies of strangulation and not a snapped neck. The noose pulls tight and oxygen rich blood no longer flows through the carotid arteries to the brain. Erection may occur, and should emission follow, it occurs after death as a result of a disseminated relaxation of the muscles. That said, I want to acknowledge that I am not a trained physiologist and have never attended a public hanging. For details I am dependent on the internet: see, e.g. the *Wikipedia* article on "Erotic asphyxiation."

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On *Problemata* 28: Temperance and Intemperance, Continence and Incontinence

Bruno Centrone

Book 28 of the *Problemata* belongs to a group of Problems which deal with ethical issues (*Pr.* 27–30), and particularly with the so-called “cardinal virtues” and their opposites: courage and fear (27), temperance and intemperance (28), justice and injustice (29), and the intellectual virtues, *φρόνησις* and *σοφία* (30).¹ While in Books 27 and 30 the physiological perspective is predominant, Book 29 is concerned only with issues unconnected to natural philosophy, given how difficult it would be to investigate justice in those terms. In Book 28, the problems posed in chapters 1–2–5–6–7 adopt the physiological point of view, whereas chapters 3–4–8 discuss philosophical questions without any reference to physiological issues, although one would expect that such topics as *ἀκολασία* and *ἀκρασία* should naturally focus on physiological issues. In chapters 2–3–7 the question raised is a linguistic-semantic one, focusing as it does on the use of the term *ἀκρατής*.

By coupling a virtue (*σωφροσύνη*) with a vice (*ἀκολασία*) and a “half-virtue” (*ἐγκράτεια*) with a “half-vice” (*ἀκρασία*), in line with Aristotle’s analysis of the matter (in *EN* 3.10–12, *EN* 7.1–10 [= *EE* 6.1–10], *EE* 3.2) the title of Book 28 announces a clear distinction between *ἀκρασία* and *ἀκολασία*. However, this distinction collapses as the book unfolds (see *infra*), since in most cases *ἀκρασία* and *ἀκολασία* are indistinctly used to describe any excess in corporeal pleasures related to touch and taste. In some cases, this is due to the adoption of a physiological perspective, within which this distinction turns out to be superfluous (e.g. in 28.1). As a matter of fact, Aristotle himself often employs the term *ἀκόλαστος* in its generic meaning of excess in the aforesaid pleasures, which also includes *ἀκρασία*, whereas the terms *ἀκρασία* and *ἀκρατής* always possess a more specific meaning. The clear distinction between *ἀκρασία* and *ἀκολασία* sometimes becomes blurred, on account of the fact that both words may ultimately be taken to indicate excessive enjoyment related to touch and taste (e.g. *EN* 7.4.1148a13–15).

¹ The literature on Book 28 is scanty: see Flashar (1962, 697–701), Louis (1994, 3–9), Mayhew (2011, 234–35).

1 *Pr.* 28.1

The physiological point of view acquires particular prominence in the first chapter. The question addressed here is why some men who are accustomed to leading an immoderate life grow ill when they change their ways. The answer is that since habit (ἔθος) soon becomes second nature, returning to one's old modes of conduct amounts to a life-saving restoration (σωτηρία, 949a32) of one's natural state. The example afforded is that of Dionysius, who having ceased drinking for a short time during a siege, soon became consumptive, until he reverted to his old drinking habits.² Dionysius is actually a typical example of an intemperate man. The most explicit testimony in this regard is found in the *Magna Moralia* (2.6.1203a22–29), where the tyrant is mentioned as an embodiment of bestiality (θηριότης) reinforced by reason.

Dionysius' sudden fall into consumption is explained as follows: in people accustomed to eating to excess, residues (περιττώματα) become mixed with a large quantity of food, so that they become watery and harmless. For the glutton, the sudden quitting of his usual diet amounts to ingesting no food at all, hence the consumption. Moreover, many non-digested residues left in his body from previous meals will make their way up into his lungs and eyes.

In order to better grasp this explanation, which is in line with the περιττώματα-theory upheld throughout the *Problemata*, it will be useful to consider some other elements.

Broadly speaking, an excess of food brings a large amount of residues, causing illness (see *Pr.* 1.22.862a14–16, 1.46.865a1–2, 5.33.884a23–25, 31.23.959b23–28). The purging of these residues (37.3.966a17–23) occurs through a heat-induced process of digestion (πέψις). The abundance of residues represents an obstacle to this process, given that it hinders the effectiveness of one's internal heat (1.6.859b13–14), and the same holds true of the cold (18.1.916b4–7, 18.7.917a20–23). According to the description given in Book 28, in the intemperate man the residues paradoxically become innocuous, being diluted by the large quantity of food. This is paradoxical, because according to this explanation an excess of food should have a beneficial effect, any remaining residues being neutralised

2 According to Forster (1927) and Louis (1994, 5), this was Dionysius the Elder: in this case the siege referred to would be that of 397–396 BC by the Carthaginians; according to Flashar (1962, 698), it was Dionysius the Younger, in which case the siege should then be dated to 357 (Dion) or possibly 343 (Timoleon). Dionysius the Younger, whose profligacy was proverbial (see *Plut. Dio.* 7) is also suggested by his mention in *Arist. fr.* 588 Rose³ (discussed shortly), although the two cases differ considerably (see *infra*). In the ethical works, Dionysius is mentioned only in *MM* 2.6 (1203a22–23); see Dirlmeier (1958, 389).

through the process just described. The implicit, underlying idea is that habit can favour the adaptation of the organism, creating a quasi-natural state that almost coincides with good health.

If the residues are not purged, the sediment of undigested matter remains active in the body, as happens in the case of black bile (see *Pr.* 1.19.861b18–20). The substances accumulated in the body of the intemperate man through his previous way of living will be gradually dissolved by his natural heat, causing violent fluxes. As the residues are undigested, they will not keep to their proper place but will rise upwards (to the head or to the lungs and windpipe), or descend into the bowels, causing dysentery (1.19.861b10–17); and when dissolved by the natural heat, they cause ophthalmia.

Now in a fragment from Aristotle's *The Constitution of the Syracusians* (fr. 588 Rose³/605.1 Gigon = Ath. 10.435D–F) we read that Dionysius (the Younger) was drunk for ninety days on end, and that for this reason he became dim-sighted.³ Indeed, a drunk man is full of moisture, and, as explained in *Pr.* 1.8.859b23–860a1, this favours ophthalmia, because a large quantity of residues are produced in moist bodies. Hence the hypothesis that Aristotle's writing could be the source of (at least some parts of) Book 28, where the doctrine that the residues travel to the eyes is mentioned.⁴ However, the (two) situations described are rather different: in Aristotle's fragment Dionysius is drunk for ninety days, while in Book 28 he is said to have given up drinking. In the first case the consequence is ophthalmia; in the second, consumption. Ophthalmia induced by drunkenness can easily be explained independently of the particular (and paradoxical) cause of illness mentioned in the *Problemata*, which consists in abandoning an unhealthy way of living.

What is rather perplexing is the fact that the explanation of the process of consumption actually works in the case of overeating, while Dionysius' intemperance concerns excessive drinking. During the siege he had ceased drinking wine, and consumption ceased when he reverted to his drunkenness.

2 *Pr.* 28.2 & 7

Chapters 2 and 7 have much in common and can be dealt with together. The questions they address are very similar: ch. 2 asks why people are said to be incontinent with respect to two senses only, touch and taste; ch. 7 asks why

³ Dionysius' drinking for ninety consecutive days is also recalled in Plut. *Dio.* 7.

⁴ Flashar (1962, 697).

those who over-indulge in pleasures related to touch and taste are called incontinent.

The main thesis, that ἀκρασία concerns pleasures of touch and taste is typical of Aristotle, but is normally formulated with respect to ἀκολασία rather than specifically to ἀκρασία. In ch. 7, however, it is further explained that those who over-indulge in sexual lust and in the enjoyments of food are called licentious (ἀκόλαστοι). In other words, it is taken for granted that this description applies to the ἀκόλαστος, and from this it is inferred that the same holds true for the ἀκρατής. This seems to indicate that from the author's point of view the difference between licentiousness and intemperance is not relevant to the topic discussed.

The answer given in ch. 2 is that, since the pleasures derived from these two senses are common to human beings and animals alike, these pleasures are the most disgraceful and the only ones open to reproach—or the ones most open to it. So the individual who is overcome by these pleasures is blamed by being called ἀκρατής and ἀκόλαστος.

This last claim is rather perplexing, for according to Aristotle only the incontinent man can be said to be overcome by pleasure, whereas in the intemperate reason and desire are in mutual accord. This seems to confirm the impression that for the author (or authors) of Book 28 ἀκρασία and ἀκολασία are essentially the same.

This thesis is repeated *ipsissimis verbis* in ch. 7, but only after a few lines (949b38–950a5) that hint at contrasting points of view about the seat of pleasure (the tongue or the larynx) in the enjoyment of food. As evidence in support of the larynx theory, the author mentions the case of one Philoxenus who prayed to have the throat of a crane. Towards the end of the chapter some examples are used to argue that the other animals derive pleasure only from the two aforementioned senses, while pleasures of a different sort are experienced by them only incidentally. This last point is reinforced, in particular with reference to smell, by illustrating the difference between the pure pleasure connected to this sense—as in the case of the scent of a rose—which is precluded to the other animals, and the incidental aspect of this pleasure, which is always connected to the pleasures of touch and taste.

The two chapters can be traced back to Aristotle, and in particular to the *Nicomachean Ethics* (3.13.1117b23–1118b8, on temperance) and the *Eudemian Ethics* (3.2.1230b21–1231a25).⁵ The physiological perspective is totally absent in them, however, and we find no significant innovations in *Pr.* 28.2 & 7.

5 *Pr.* 28.7 is quoted almost in its entirety (except for 950a12–16) by Aulus Gellius (19.2), where it is ascribed to Aristotle.

Very close parallels are to be found between *Pr.* 28.7 and *EN* 3.13. In *EN* 3.13 Aristotle sets out to define the specific sphere of application of σωφροσύνη: he states that this virtue has to do with bodily pleasures, and more specifically with those of touch and taste. Overindulgence in the pleasures of sight and hearing is certainly possible, but in this case no one would speak of temperance or licentiousness, unless accidentally, for these pleasures are only enjoyed by way of a mnemonic association, which reminds one of other pleasures. This is confirmed by what happens among other animals. Temperance and intemperance concern those pleasures which man shares with the lower animals, namely the pleasures of touch and taste, which consequently are slavish and bestial.

That the pleasure of the licentious man is derived from touch is confirmed by the episode of the gourmand wishing that his throat were longer than a crane's. This man, Philoxenos—who is also mentioned in Book 28—is only explicitly named in *EE* 3.2.1231a15–17, where reference is made to the tongue-larynx alternative hinted at in the *Problemata*: since the other animals are not sensitive to the pleasures perceived through the tip of the tongue, but only to those perceived through the throat, the corresponding affection is closer to touch than taste (*EE* 3.2.1231a12–15). The use of the *Eudemian Ethics*, therefore, seems certain. On the other hand, perfect parallels with the *Nicomachean Ethics* are to be found in the example of the scent of a rose and in that of the lion, which are used to demonstrate that pleasures of smell are only incidental in other animals. It is probable, then, that the author of ch. 7 used both the *Eudemian* and the *Nicomachean Ethics* as his sources.⁶

Ch. 7 further develops the main thesis by explaining that, although there are five senses, the other animals only derive pleasure from the two aforementioned one, while they derive no pleasure at all from the others, or only incidental enjoyment:⁷ the lion who sees (or smells) his prey rejoices because he anticipates the pleasure of digging his teeth into it. In other words, in order to prevent the objection that an animal under certain circumstances might experience pleasures of sight (or smell—that is, pleasures which admit no intemperance), the author clearly points out that in these cases enjoyment does not concern the particular sensation at stake, but the thing this very sensation recalls; and the corresponding pleasure is once again a pleasure of touch or taste.

This claim is not very perspicuous in itself, but can be explained by turning to its probable source. In *EN* 3.10.1118a18–23, Aristotle explains that hounds do

6 See Flashar (1962, 700–701).

7 This idea is criticised by Plutarch (*Quaest.conv.* 7.5 [*Mor.* 704e–f]), who quotes Aristotle in this regard.

not take pleasure in scenting hares, but in eating them, just as the lion does not take pleasure in the lowing of the ox, or in seeing the stag, but in devouring them; smell—or sight or hearing—is only a medium for the sensation; the lowing of the ox tells the lion that his prey is near, and consequently he takes pleasure in this sound.

The pleasure at stake, then, is only incidental, as is shown by the fact that sometimes, when the conditions favouring pleasures of replenishment are not given, these supposed pleasures are no pleasures at all: the smell of food is agreeable only if one is not already sated. The pure pleasures of the other senses, instead, such as the one deriving from the scent of a rose, are always agreeable.

Chapter 7 seems to provide an adequate answer to the question posed in ch.2: why we speak of incontinent people with respect to *two senses only*, touch and taste (Διὰ τί κατὰ δύο μόνας αἰσθήσεις ἀκρατεῖς λέγομεν, οἷον ἀφήν καὶ γεῦσιν, 949b6–7). The two questions posed do not seem to differ substantially, but in ch. 7 a more specific problem can be detected: why, among people who exceed with regard to some pleasures, only those who exceed in respect of pleasures of touch and taste are said to be incontinent—the unexpressed implication being that those who exceed in respect of pleasures of sight and hearing are not really incontinent at all. The phrase οἱ δὲ κατὰ τὴν ὄψιν καὶ τὴν ἀκοὴν οὐκέτι (950a4–5) is in fact the natural continuation of the initial question, interrupted by the clarification made in 949b38–950a4.

In other terms, the more specific problem is why, although it is possible to exceed in respect of pleasures of sight and hearing as well, we speak of incontinence only with regard to pleasures of touch and taste. Such a formulation appears to imply the concessive clause found in *EN* 3.10.1118a5–7: “although it would be held that these things (i.e. things which are the object of sight and hearing) also can be enjoyed in the right manner, or too much, or too little” (χαίτοι δόξειεν ἂν εἶναι καὶ ὥς δεῖ χαίρειν καὶ τούτοις, καὶ καθ’ ὑπερβολὴν καὶ ἔλλειψιν). The point here is not that excess is possible only in pleasures of touch and taste, but rather that we do not speak of ἀκρασία merely with reference to overindulgence in some pleasures. Aristotle’s answer—as has already been shown—is that for the intemperate man enjoying pleasures of sight, hearing, and smell is only accidental, owing to the evocative potential of the corresponding sensations, as is revealed by the comparison with other animals. This claim appears at the end of chapter 7, but only a comparison with Aristotle’s text explains its presence.

It seems, then, that ch. 7 represents an extension of—and improvement upon—ch. 2, as it specifies the initial question, picks up the answer given in ch. 2, and in its final part further defines the same question, while at the same time working out a more complete answer.

3 *Pr.* 28.3

A linguistic-semantic perspective clearly underlies the odd formulation of the question in ch. 3: why are people called incontinent (*ἀκρατεῖς*) only in respect of their desire, although incontinence also exists with respect to anger (949b13–14). In this case it is unavoidable for the author to speak of *ἀκρασία*, and not of *ἀκολασία*, for in respect of anger incontinence only, and not intemperance, is possible. Indeed, the *ἀκόλαστος* acts voluntarily and deliberately, whereas anger, as a *pathos*, is involuntary.

This way of formulating the problem is rather strange: the existence of an *ἀκρασία ὀργῆς* is taken for granted, but at the same time the corresponding denomination in everyday language is excluded. The author is apparently basing his views on the *result* of the Aristotelian inquiry in the *Ethics*, where *ἀκρασία* is confined to desire and to the corporeal pleasures of touch and taste; he considers the corresponding linguistic use as being well-established and normative, yet at the same time objectively in conflict with the actual existence of incontinence in anger. In its second occurrence the term *ἀκρασία*, then, has the generic meaning of lack of self-control, while in the first it is taken in the more restricted sense established by Aristotle. So, the author's point of departure is the opposite of Aristotle's: Aristotle's initial point of view is the objective fact that we usually speak of *ἀκρασία* not just with reference to corporeal desires, and the outcome of his analysis is the semantic restriction expressed through the adverb *ἀπλῶς* (see *EN* 7.3.1145b19–20; 4.1147b20–1148b14; 5.1149a21–24; *EE* 2.7.1223b18–19 and *infra*). Book 28 instead simply assumes this semantic restriction, which is considered at variance with the facts. Furthermore, by taking for granted the existence of an *ἀκρασία ὀργῆς*, the author ignores the complexity of the Aristotelian approach to this matter.

The answer given (949b14–19) is that *ἀκρατής* and *ἀκρασία*—which are distinct insofar as the former describes an agent (*πράττων*), the latter a mode of conduct (*ἀγωγή*) or way of living—are both contrary to reason, whereas feelings of anger are accompanied by reason (*μετὰ λόγου*), not in the sense that reason imparts an actual order (*οὐχ ὡς κελεύσαντος τοῦ λόγου*), but because reason indicates (*δηλώσαντος*) that a certain action (or accusation, *αἰτία*)⁸ represents an insult.

8 Only Flashar translates *αἰτία* with “cause” (*Ursache*). Sylburg emends this to *αἰκία* (“affront”, “outrage”), which, besides giving a good sense, occurs in *EN* 5.2.1131a9 within a list of violent forms of injustice, together with *προπηλακισμός*, the term used in *Pr.* 28.3.949b19 (for *προπηλακισμός* as a possible cause of anger, see *EE* 3.3.1231b12 and *EN* 4.5.1126a7). Moreover, in *Rhet.* 2.3 there is no mention of “accusation” as a possible cause for anger.

This reference to the λόγος brings out the cognitive content of the emotion: according to the definition proposed in the *Rhetoric* (2.2.1378a30–32) and in the *De anima* (1.1.403a30–31), anger is a longing for revenge for an apparently undeserved slight. In order for someone to get angry, a rational evaluation is then needed, although in the *Rhetoric* it is connected to the imagination (διὰ φαινομένην ὀλιγωρίαν), as a more general cognitive faculty, rather than to reason (the alternative between λόγος and φαντασία is mentioned in *EN* 7.6.1149a32: ὁ μὲν γὰρ λόγος ἢ ἡ φαντασία).

In order to grasp the relationship between *Pr.* 28 and Aristotle's writings, with the aim of assessing their similarities and differences, it is worth examining Aristotle's position concerning the question of incontinence in anger.

The existence of an ἀκρασία θυμοῦ is considered a generally shared view in the *Ethics*. In *EN* 7.1.1145b19–20 it is referred to as a consolidated linguistic usage (ἀκρατεῖς λέγονται καὶ θυμοῦ καὶ τιμῆς καὶ κέρδους). Indeed, corresponding formulations are to be found before Aristotle (for example in Thucydides and Plato),⁹ but more generally Aristotle seems to be referring to the obvious idea that lack of self-control in anger is possible. The question is dealt with in detail in *EN* 7.7 and *EE* 3.2. According to Aristotle's analysis, there is no incontinence, properly speaking, in respect of anger; if we speak of incontinence, it is only with further qualifications, according to the ἀπλῶς-κατὰ πρόσθεσιν distinction: an incontinent *simpliciter* is an individual who pursues pleasures of touch and taste, not deliberately, but in conflict with reason, whereas other types of ἀκρασία require further specification, as in the case of incontinence in anger. It is possible to speak of ἀκρατεῖς θυμοῦ, but only by similarity (καθ' ὁμοιότητα, *EN* 7.4.1147b34). This distinction is totally absent from *Pr.* 28, which simply assumes the existence of incontinence in anger, possibly for reasons of conciseness.

Incontinence in anger (*EN* 7.6.1149b24–1150a8) is held to be less disgraceful than incontinence in desire, for the one who fails to restrain his anger is in a way controlled by reason, although he/she misunderstands it, while the other type yields to desire straightaway. When the spirit takes vengeance, it somehow *follows* (ἀκολουθεῖ) reason, whereas desire, at a mere hint from the senses that a thing is pleasant, rushes off to enjoy it. The underlying idea seems to be that incontinence in desire, being more primitive and involving a lesser degree of rationality (or excluding it completely), is more disgraceful, while incontinence in θυμός is peculiarly human and therefore more honourable.

9 See Th. 3.84.2.1–5: ἀκρατὴς ὀργῆς; Pl. *Leges* 869a2: ἀκρατὴς θυμοῦ. Consequently, courage is sometimes defined as ἐγκράτεια; see Pl. *Def.* 412a3–5 and Dirlmeier (1956, 477).

Aristotle's description turns out to be problematic in a variety of ways. The difference between the two cases is all but clear, for both spirit and desire act in conformity with the λόγος ("an insult occurred," "this thing is pleasant": the latter is also an indication from the λόγος—ἐὰν μόνον εἴπῃ ὅτι ἡδὺ ὁ λόγος ἢ ἡ αἴσθησις [7.6.1149a34–35]—unless one accepts the excising of ὁ λόγος proposed by Rackham). Moreover, it is not clear what the contribution of reason consists in, that is to say, whether reason issues an actual order which the θυμός misunderstands, or whether reason furnishes a mere indication, a factual assertion, which is interpreted as an order by the θυμός. Particularly ambiguous in this regard is the clause ἀκούσας μὲν, οὐκ ἐπίταγμα δ' ἀκούσας (*EN* 7.6.1149a30–31).¹⁰

Aristotle's description seems to indicate that what distinguishes the θυμός from desire is a sort of syllogism which starts from the general indication given by reason. The incontinent in anger acts according to reason, as the θυμός produces a sort of inference (ὥσπερ συλλογισάμενος, *EN* 7.6.1149a33): "There has been an offence, so one has to fight against the offender" (δεῖ τῷ τοιούτῳ πολεμεῖν, 1149a33–34). Aristotle observes that the incontinent in anger (ἀκρατὴς θυμοῦ) is in a way overcome by the λόγος (τοῦ λόγου πῶς ἡττᾶται, 1149b3). Now, this λόγος cannot simply be the indication of an insult on the part of one's reason (for this indication is correct, and consequently the incontinent's being overcome by the λόγος could not be regarded as something negative). Rather, it must be the conclusion of the syllogism, namely the idea that the individual ought to turn straightaway against anyone insulting him.

To sum up, what causes incontinence in anger to be more akin to reason than incontinence in desire is not simply the cognitive content of the emotion,

10 On this problem, see Natali (2009, particularly 116–18) with a review of various translations of the passage. For an overview of the main interpretations, consider for instance Rackham (1926): "hears, but does not hear the order given"; and Ross: "though it hears, does not hear an order." The latter is ambiguous to my mind, for it is not clear whether reason actually imparts an order. A more unambiguous translation is provided by Dirlmeier (1956, 153): "dabei hat er zwar etwas gehört, aber das Gehörte mit einem (tatsächlichen) Auftrag verwechselt." Among the ancient interpreters, Aspasius' interpretation is very close to that of Book 28: see *in EN* 127.9.10: τῷ παρακοῦσαι τοῦ λόγου ἄλλο τι λέγοντος ὥσπερ προστάγματος [δ] ἀκούσας ὁρμᾷ; see also Anon. *in EN* 145.36–146.2. The interpretation of the Anonymus (*in EN* 7.430.11–25 Heylbut) οὐκ ἀκοῦσαι δὲ ἐμμείνας τὸ πρόσταγμα, εἴτε δεῖ τιμωρῆσαι αὐτὸν εἴτε μὴ, ὁρμᾷ πρὸς τὸ τιμωρῆσαι is slightly different: the *thymos* does not wait to hear the order that reason is about to give—whether it must act straightaway or not—but rushes off to take vengeance. In the former case, the *thymos* mistakes something as an order (the ἐπίταγμα being an alleged order); in the latter case, it does not wait to hear an order (the ἐπίταγμα here being interpreted as the actual order that will come from reason).

but the following quasi-syllogism that prompts the action. We find no trace in Book 28 of any other arguments advanced by Aristotle (*EN* 7.6.1149b13–26) to establish that incontinence in desire is more disgraceful.

According to some interpreters, this chapter of Book 28 significantly departs from Aristotle's views, insofar as the contrast between reason, anger, and desires is strongly influenced by Plato's tripartition of the soul and its internal dynamics. The author seems to ignore the doctrine of the right mean, which implies, under certain conditions, a positive evaluation of anger. This has led to the conclusion that *Pr.* 28.3 is not Aristotelian in content.¹¹

It is to be noted, however, that the inner opposition of the soul typical of incontinence is always described by Aristotle in terms of a conflict between reason on the one side, and spirit and desire on the other. The difference with Plato remains considerable, due to the general conception of the soul within which these elements are framed. The parallels between *Pr.* 28 and Aristotle are actually striking: first of all, the λόγος indicates (*Pr.* 28.3.949b18: ὡς δηλώσαντος, cf. *EN* 7.6.1149a33: ἐδήλωσεν) that there has been an insult. Both in the *Nicomachean Ethics* and in *Pr.* 28 the incontinent in anger listens to reason in one sense, but misunderstands it (παρακοῦειν, *EN* 7.6.1149a26), or acts contrary to it (παρὰ τὸν λόγον, *Pr.* 28.3.949b15), in the other. In both texts desire acts contrary to the λόγος (παρὰ τὸν λόγον, *Pr.* 28.3.949b15–16; ἢ δ' ἐπιθυμία οὐ ἀκολουθεῖ τῷ λόγῳ, *EN* 7.6.1149b1–2). It seems most likely, then, that the author was drawing upon these very passages of Aristotle's *Ethics*. The author's treatment of the matter thus remains close to Aristotle's, and Platonic resonances in the text should not be overestimated. Unlike in Aristotle, however, in *Pr.* 28 the contribution of the λόγος is only found in the judgement that an insult has occurred. It becomes necessary, then, for the author to point out that the λόγος accompanying anger is not an order imparted by reason (οὐχ ὡς κελεύσαντος τοῦ λόγου)—for if it were, one could not speak of ἀκρασία.

This is probably how the author interprets the controversial passage in *EN* 7.6.1149a30–31: ἀκούσας μὲν, οὐκ ἐπίταγμα δ' ἀκούσας. A possible interpretation of this clause is that the θυμός can be said to listen to reason in a way, but what it heeds is not an order: for the order to act is the result of the subsequent syllogism, for whose conclusion the θυμός is, in a way, responsible (ὃ δ' ὥστερ συλλογισάμενος [1149a33] must refer to the θυμός).¹² In the *Problemata*, too, reason does not order the spirit to act, but only indicates that an insult has occurred.

¹¹ Flashar (1962, 698–99).

¹² See Natali (2009, 117): both premises of the syllogism (“one has to fight against an offence” and “there has been an offence”) are provided by the λόγος, which however has not yet subsumed the particular premiss under the universal one; the mistake of the θυμός is

Chapter 3, then, does not depart significantly from Aristotle's position in the *Ethics*, except for a different explanation of why incontinence in anger is closer to reason than incontinence in desire.

What is more doubtful is the idea that the thesis upheld in chapter 3, while remaining essentially faithful to Aristotle, provides an adequate answer to the question posed. The basic question, in any case, is a legitimate one, insofar as Aristotle's claim that only incontinent in respect of desire are properly called ἀκρατεῖς requires an explanation. If the expression ἀκρατεῖς λέγονται (*Pr.* 28.3.949b13) is interpreted as indicating the appropriate term to be adopted, as expressed by Aristotele through the addition of ἀπλῶς, the author of *Pr.* 28 is endeavouring to explain the reason for Aristotle's attempt to restrict the use of the word.

The author's answer is that the real meaning of ἀκρατής is "contrary to the λόγος"; and what is contrary to the λόγος is properly desire, not anger. The point made is not implausible: if ἀκρασία means lack of self-control and being overcome (by pleasure or by something else), and if what is overcome is reason, then ἀκρασία will be that which is most opposite to the λόγος; what is more proximate to reason, by contrast, will not be ἀκρασία in the proper sense.

This line of reasoning implies a further development compared to Aristotle. In *EN* 7.6, Aristotle introduces the thesis that (a) incontinence in anger is less disgraceful, after having already demonstrated that (b) incontinence in the proper sense concerns the pleasure typical of intemperance, while other forms of incontinence are such only by analogy. In other words, he does not seem to consider (a) a possible explanation of (b). However, there is some merit in the implicit idea that any description of ἀκρασία is bound to refer to the λόγος as the main counterpart to the incontinent's way of acting.

4 *Pr.* 28.4

The fourth chapter addresses the question of why we value continence and moderation most in the young and the rich, but justice in the poor. The answer is that we especially admire those who abstain from what they need the most, and the poor person needs resources, whereas the young and rich need enjoyment.

The idea that temperance is most valued in the young was a traditional one in ancient Greece (consider, for instance, Plato's *Charmides*). It also occurs in

simply to act straightaway, as if reason had deliberated and worked out the conclusion "I have to fight against *this* man."

Aristotle's writings. In the *Rhetoric* it is presented as a virtue most valued in the young (1.5.1361a3–4), for the young are inclined to be courageous and intemperate, while the old are temperate but cowardly (2.14.1390b4–6). A more precise parallel is found in the *Topics* (3.2.117a30–33), where Aristotle observes that σωφροσύνη, like courage, is more necessary in youth, for the young are more troubled by their desires than the old. As concerns justice, the most precise parallel is *Rhet.* 1.12.1372b19–21: all those who are in need are more inclined to commit acts of injustice, including the poor, for they lack the bare necessities in life. In Book 29, which has justice and injustice as its main subject, there are no parallels to this thesis, except for the complementary idea that the unjust man is such with reference to wealth (950a24–25).

5 *Pr.* 28.5–6

The question dealt with in chs. 5–6, although differently formulated, is essentially the same: why thirst is more difficult to endure than hunger (in ch. 5, why people *tolerate* [ἦττον ἀνέχονται, 949b26] being thirsty *less* than being hungry; in ch. 6, why we *endure* [ἦττον καρτεροῦμεν, 949b32] being thirsty *less* than being hungry). The conclusions reached are also the same. In ch. 5, however, an answer is provided that is not found in ch. 6: vital bodily heat (τὸ θερμὸν ᾧ ζῶμεν) requires more moisture than dryness. The other two explanations given are: (a) that thirst is more painful, as is shown by the fact that drinking is more pleasant when one is thirsty than eating is when one is hungry; and (b) that thirst is a desire for two things, drink (cooling [κατάψυξις] in 6.949b35) and nourishment, whereas hunger is a desire for only one of the two, nourishment.

The question posed falls outside the issues indicated in the title of the book, for a situation in which one suffers thirst or hunger is normally the opposite of those in which incontinence and intemperance occur. The disposition at issue is rather endurance (καρτερία), as indicated by the use of the verb καρτερεῖν, which appears nowhere else in the *Problemata*.

Instead, the topic of drinking recurs again and again in the work. Thirst is caused by the overheating of the body (5.30.884a3–4; 27.3.947b36–37; 4.948a19–20, 8.948b14–15, et al.) and the consequent loss of moisture. Now thirst is not quenched by filling the stomach; rather, in *Pr.* 22.6 it is observed that one should drink not only because of the thirst that comes *while* eating solid food, but also *after* solid food, for drinking is not only a necessity (930b12–14); for this reason one eats “fruits” (τραγήματα, b12) at the end of the meal. We do not cease being thirsty when the stomach is full, but when each part of the body has drawn in its own proper liquid, and when they have received

this sufficiently (22.2.930a19–23). So, the one who is hungry is in need only of nourishment, whereas the one who is thirsty drinks both for the sake of nourishment (for drink contains nourishment as well) and in order to cool the vital heat (ἄμφω γὰρ ἔχει τὸ ποτόν, 949b35). For this reason in ch.5 it is further specified that health requires more moistness than dryness.

Now, if above is adduced as the main answer to the question posed, the phenomenological datum that eating extinguishes hunger, but not thirst, is by no means irrelevant here, for it confirms that thirst requires two factors.

6 *Pr.* 28.8

This short chapter asks why men are less restrained in laughter when their acquaintances are present. The answer is rather unclear, given the corruption of the text.¹³ Based on the lines handed-down to us, it is possible to infer that laughter is more easily elicited by goodwill, for goodwill stimulates talkativeness. I quote the entire chapter:

Διὰ τί ἦττον κατέχουσι τὸν γέλωτα παρόντων τῶν γνωρίμων; ἢ ὅταν σφόδρα ἐξηγμένον ἦ τι, εὐκίνητόν ἐστιν; ἢ δ' εὐνοια εἰπεῖν μᾶλλον γελοῖον, ὥστε κινεῖ.

Why do people hold back their laughter less when acquaintances are present? Is it that when anything is very much excited, it is easily set in motion? Now goodwill [involves people] saying more of what is laughable, such that it moves us. (Mayhew trans.)

The underlying idea seems to be that goodwill involves more indulgence towards other people, whereby one will be more inclined to say something ridiculous without holding back and with little concern for others' reactions; likewise, one will not feel ashamed if one breaks into laughter. Goodwill, then, more easily moves to laugh.

Restraining laughter is an old Pythagorean precept (DL 8.23), and it is understandable that such an issue is addressed within the main theme of the lack of self-control (ἀκρασία). A fleeting reference to the subject is to be found within the treatment of ἀκρασία in *EN* 7.7.1150b8–16. Here Aristotle observes that it is more excusable for a person to yield to strong and excessive pleasure after an

¹³ Forter's suggested reconstruction—ἢ δ' εὐνοια ἐξαίρει, ὥστε κινεῖ μᾶλλον τὸ γελοῖον (950a19)—makes sense, but stretches the text considerably.

effort to restrain himself, and that this is also the case for people who suddenly break out into boisterous laughter.

The topic of laughter is addressed elsewhere in the *Problemata* (11.13, 15, 50; 35.6) from a physiological point of view.

7 Conclusion

7.1 Summary Remarks

Taken as a whole, Book 28 shows a certain lack of coherence and a distinctly rhapsodic character. The work addresses a variety of questions and adopts a wide range of perspectives in dealing with the different topics.

The physiological point of view, which one might reasonably expect the *Problemata* to adopt, turns out to be decisive in chs. 1–5–6, and partially in chs. 2 & 7. The answers given in these chapters to the questions posed are consistent with the physiological theories upheld throughout the *Problemata*, as many parallels confirm. Perhaps, the adoption of a physiological perspective is also responsible for blurring the clear distinction between ἀκολασία and ἀκρασία stated by Aristotle, and this is the source of some inaccuracies, such as the claim that the ἀκόλαστος (instead of the ἀκρατής) is overcome by pleasure.

Such an approach, however, is not always applied, even in cases where a physiological analysis would be appropriate for the topic addressed. A clear example is the treatment of ἀκρασία, which is only considered in its physiological aspects in ch. 1, whereas in chs. 2, 3 and 7 the question addressed merely concerns the use of the term ἀκρατής (and the same applies to the few lines devoted to the topic of laughter).

The author rarely goes beyond Aristotle. Sometimes, the way he addresses the questions posed reveals that he is only assuming and summarizing the results of Aristotle's analysis rather than using them as the basis for a more in-depth inquiry. This is also a good reason not to attribute Book 28 to Aristotle.

In chapter 7, for example, only a comparison with Aristotle's text clarifies the point at issue (i.e. the accidental nature of the pleasures of sight and hearing for animals). Sometimes a linguistic-semantic perspective—*de facto* absent from the remaining *Problemata*—prevails in a rather unexpected way, and the questions addressed mainly concern linguistic usage. Here some differences with Aristotle are visible, although they are partly concealed by the author's close adherence to the Aristotelian text. In ch. 3 (as well as in 2 and 7), the author presupposes the results of the Aristotelian inquiry, which he considers to be at variance with the facts: Aristotle restricts the proper meaning of ἀκρασία to incontinence in respect of pleasures of touch and taste, excluding

that incontinence in anger could be ἀκρασία in the proper sense. Our author, instead, takes this linguistic use of ἀκρατής as a starting point, seeing it as being at variance with the actual existence of incontinence in anger. Indeed, the interpretation, in ch. 3, of the term ἀκρατής as meaning “contrary to the λόγος” goes beyond the Aristotelian text and serves the purpose of answering a question which is not addressed as such by Aristotle: why those people who exceed in pleasures of touch and taste *are called* ἀκρατεῖς. In ch. 3 the author seemingly misinterprets Aristotle’s explanation of why the θυμός is more akin to the λόγος than desire (although one has to admit that the corresponding passage in the *Nicomachean Ethics* (1149a24–b3) is all but perspicuous). In ch. 7 the author faithfully employs Aristotelian material, which however was not originally intended to answer the question at issue.

7.2 *Chronology*

The arguments which some scholars have brought forward in an attempt to establish a precise chronology are in no way reliable. Louis (1994, 5) attributes Book 28 to Aristotle himself, dating it to the period of his first sojourn in Athens. However, nothing supports Louis’ impression that the siege mentioned in ch. 1 was a recent occurrence, not to mention the difficulty of dating this historical event precisely.¹⁴ The fact that from a certain moment onwards the tongue had come to be recognised as the seat of taste (“apres lui [sc. Aristote] la localisation du gout dans la langue ne fer plus de doute”) is no reliable evidence for dating the *Pr.* 28: the alternative mentioned in ch. 7 between tongue and throat does not refer to opposite *theories* on the seat of taste—one of which was destined to prevail at a certain point—but rather to separate seats of pleasure (τὸ ἡδύ, 950a3). It mirrors objective facts (the pleasure derived from food being connected to both the tongue and the throat) and subjective points of view, hinting at the difference between a gourmet and a glutton.

It seems highly probable, therefore, that these chapters are later than Aristotle, while there is no evidence for assigning *Pr.* 28 to a period later than the early Peripatos. It is hard to ascertain anything more about this brief treatise.

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¹⁴ See *supra* note 2.

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Problemata 29 and Athenian Law

David C. Mirhady

Book 29 of the *Problems* offers a fascinating set of questions.¹ I will summarize what I take to be their key points: If honor is more important than money, why do people litigate more over money than honor (1)? Why is it worse to steal a deposit than a loan (2, 6)? Why does birth count more than a will in an inheritance (3)? Why does wealth not follow moral probity (4, 8)? Why are the injustices of speech and other matters not greater (5)? Why is a human, despite being the most educated of animals, also the most unjust (7)? Why is it more just to defend the dead than the living (9)? Why does associating with good people make one better (10)? Why is it worse to kill a woman than a man (11)? Why do defendants in law courts stand on the right (12)? Why does the defendant win when the jury's vote is tied (13, 15)? Why is theft from a bathhouse punished so harshly (14)? Why is *hubris* punished less harshly than theft (16)?

As my references to the question numbers indicate, several of the problems are repeated, which suggests that the ancient editing of the text was more a matter of compilation than systematic presentation. The Budé editor, Pierre Louis, notes the reference to bathhouse culture (in *Pr.* 29.14) and so rejects a classical Greek composition and editing for the collection, opting in fact for the 2nd century of our era (1994, 3:13). Indeed, there are precious few points where precise resonances with what we know about Athenian law during Aristotle's time—mostly from the Attic orators—can be detected. Admittedly, Aristotle's own familiarity with and regard specifically for Athenian law and legal practice are themselves not particularly strong, other than in the *Athenaion politeia*,² and its authorship is notoriously disputed. But even with the Aristotelian writings on justice themselves, in *Nicomachean Ethics*, *Magna Moralia*, *Rhetoric*, as well as the *Athenaion politeia*, this book's correspondences are very imprecise. There seems almost a conscious effort to delocalize and detemporize its discussions, to say nothing of a lack of a recognizably strong philosophical perspective. As a collection of problems, *Pr.* 29 lends itself to being compiled over time. However, for students of this text who are less

1 The notes of Flashar (1962, 702–10) are quite helpful.

2 See Mirhady (1991) and (2006).

familiar with Athenian law, and particularly with Athenian law court oratory, it seems worthwhile to try to draw some connections, however vague.³

The premise of the book seems to be that systems of justice create paradoxes: although honor is more esteemed, money is a greater focus of justice systems; although the same amount of money may be stolen whether as a deposit or a loan, the theft of a deposit is more shameful; and so on. There then follow a number of possible explanations of the paradoxes, and in one instance (13) eight possibilities are explored in some detail and another is mentioned in a repetition of the problem (15). That raises several interesting questions. First, are the premises of the problems true, or understood by the author as true, or commonly held to be true? Is honor really more esteemed than money, for instance? A related pair of questions arises with regard to the explanations: is the “fact” cited in the explanation true, and does it indicate a sufficient explanation? Is it, for instance, in fact impossible to counterfeit a birth (3), and if it is, is that why birth takes precedence over wills? Since we cannot delimit the text in terms of time or place, it is impossible to answer these questions historically with regard to any specific underlying legal background. In terms of the text itself, however, it seems as if the premises and the cited “facts” are indeed meant to be accepted as true, but there seems a studied ambivalence regarding the facts’ explanatory value, which is why multiple alternative explanations are offered.

In very few cases, if any, do the explanations seem entirely satisfactory, especially if one thinks of classical Athenian legal culture. Even in the problem of why defendants win tied votes, none of the nine explanations really seems to hit upon the right answer. It seems instead as if the possible explanations are meant rather to provoke further discussion, presumably among groups of students, as a means of dialectically exploring the underlying principles of justice. As a pedagogical tool for provoking student thought, it seems excellent.

Because the problems in this book all deal with justice, its evaluative criteria also employ a wide range of moral vocabulary outside of justice alone. Actions are to be avoided, for instance, not only if they are more unjust, but also if they are thought to be (δοκεῖ) more shameful (αἰσχρόν), terrible (δεινότερον), base (φαῦλον), or cause ourselves to become indignant (ἀγανακτοῦν). The subjective element is prevalent. In 29.2 stealing a deposit is “more terrible,” but in 29.6 it is “more shameful.” Arguments that something is contrary to the laws

3 There is repeated reference to “the lawgiver” in *Pr.* 29.13–14 that follows a pattern of appeals to Solon the lawgiver in Athenian forensic oratory, but Solon is not mentioned here. It seems best to acknowledge that this pattern of argumentation followed an Athenian model and then developed well beyond it, dropping his specific name.

or disadvantageous (to the polis)—staples of Athenian forensic oratory⁴—hardly appear, nor does any mechanism for seeking redress for those actions deemed unjust, other than with regard to several harsh penalties, which seem rather a mechanism for measuring the extent of injustice.

In what follows, I try to shed light on the nature and cultural context of each chapter/problem or related set of chapters/problems.

1 *Pr. 29.1*

I have summarized 29.1 as “why do people litigate more over money than honor,” which admittedly goes somewhat beyond the literal “injustice with regard to money is thought to be greater” (ἡ τῶν χρημάτων ἀδικία μᾶλλον δοκεῖ), but my sense is that the relative frequency of litigation over money rather than honor was the primary evidence for the author’s claim.⁵ In Athens the primary means of litigating over honor seems to have been the γραφή ὕβρεως (cf. Dem. 21.47), inasmuch as *hubris* was fundamentally an affront to the honor of another, but in fact that charge seems to have specifically concerned violence that causes dishonor.⁶ Both Isocrates 20 and Demosthenes 54 were written for cases of violent assault, but much of the actual argumentation in those speeches concerns *hubris* in a sort of rhetorical *a fortiori* argument: the prosecution charge might have been *hubris*, which is more serious, but it is only for assault, so since there are many indications of *hubris*, the defendant must be guilty at least of assault (Isoc. 20.2; Dem. 54.1). The fact that even in those cases the prosecution charge was not in fact *hubris* (and so the act of dishonoring) suggests how seldom such cases occurred. Demosthenes 18 (*On the Crown*), on the other hand, concerns an attempt by Demosthenes’ friend Ctesiphon to have the Athenian assembly bestow an honorific crown on Demosthenes, but that case only entered the legal, rather than the political, sphere when Aeschines prosecuted Ctesiphon, claiming that the proposal was illegal. Thus the case turns somewhat on the honor of Demosthenes, but only indirectly, since the direct charge is against the illegality of Ctesiphon’s proposal.

4 Cf. [Arist.] *Rh. Al.* 4.2; Dem. 20.114, 37.47, 41.14, 57.1; Is. 1.40; Lyc. 1.20, 33; Lys. 23.16.

5 Aristotle, *EN* 8.14.1163b3–18, discusses distinctions between honor and profit (κέρδος) in the context of friendship, public life, and families, not justice.

6 See Todd (1993, 270).

There may also be an implicit social commentary in 29.1 along the lines that traditional (sc. Homeric) values prize honor (τιμή) rather than money,⁷ but nowadays people's (moral) choice (αἰροῦνται) is for money, which is "most common" (vulgar?), over honor, which is itself seldom of use (χρησις). If such a commentary is really intended, it seems consistent with a Peripatetic social critique. But it is not fleshed out. The absence of money in the Homeric poems certainly seems a factor.

2 *Pr. 29.2 & 6*

In 29.2 it is more terrible ("shameful" in 29.6) to steal a deposit (even a small one, 6) than a loan. With this problem the assumption of the premise brings a lot of cultural baggage. Does "more terrible" (δεινότερον) mean that there actually were no harsher penalties for theft of a deposit—otherwise it would be more "unjust"—but that it brought greater social opprobrium? Are deposits actually made only with "friends"?⁸ Interestingly, Aristotle raises this issue, ever so briefly (*Rhet.* 2.4.3 1381b21–22), in a passage on behaviors causing shame (αἰσχύνη); the shame is caused by (the acknowledgment by the perpetrator of) his own act of injustice.

Isocrates 17 is a prosecution speech against a banker who has allegedly stolen a deposit:

Dealings with people at banks occur without witnesses, and those who have suffered injustice at their hands must run a risk against people who have many friends, who handle lots of money, and who appear credible because of their trade (2).

The original function of "people at banks" was to be currency exchangers, at the port of Piraeus for instance, for importers and exporters in Athenian trade. But they developed the sideline of accepting deposits, originally presumably to safeguard the money of visitors to Athens or, as in Isocrates 17, to hide it from

7 One could admittedly argue that the *Iliad* is about measuring honor not in material terms (γέρας) but in terms of renown (κλέος).

8 The sense of ἀμύνεσθαι as "repay" (950a34) seems to me closer to the cognate Latin *remunere* than what we might expect in classical Greek (see ἀποδώσειν in Isoc. 17.19, 21). However, ἀμύνεσθαι here may mean something like "to defend one's interests" (on equal terms).

the predations of authorities back home.⁹ There was no expectation of earning interest from them. Nevertheless, Isocrates' claims that dealings with those at banks were without witnesses and that bankers had lots of "friends" both indicate a "deposit culture" that is consistent with our text, although it itself makes no mention of bankers. It does, however, rely heavily on the cultural assumption that deposits are made with "friends" and so both the deposit and the friendship are at stake with the fidelity of the deposit relationship.

Demosthenes 32–38 are all speeches concerned with business loans, mostly for shipping grain. In these cases there was an expectation of profit, as much as thirty percent per voyage (Dem. 34.23), and the expectation of risk was accepted. But the risk was to be mitigated by the requirement that the investment of the borrower had to match that of the lenders (cf. Dem. 32.4). Demosthenes 32, however, documents how multiple loans could surreptitiously be taken out on the same cargo: if the ship went down, the obligation to repay any of them disappeared according to the norms of maritime trading contracts (συγγράφαί). The many speeches in the Demosthenic corpus that are devoted to litigation over loans, rather than deposits, testifies to the fact that in law stealing a loan was dealt with much more commonly. And indeed, such dealings were not among "friends" at all.¹⁰

3 *Pr. 29.3*

The mention of "some law courts" (ἐνίοις δικαστηρίοις) in 29.3, where people vote on the basis of births rather than wills, suggests that the author, like Theophrastus in his *Nomoi* (589 no. 17a–c FHS&G), is considering a variety of legal systems. Of course, he may be referring to different law courts within a single legal system, such as the Areopagus as opposed to the popular courts in Athens, but that seems unlikely since inheritance cases would seem to fall only to one sort of court in a given jurisdiction. Todd (1993, 380) states that it was "notorious that Athenian [judges] tended to rank the claims of relatives ahead of the intentions of testators."¹¹ That seems the sort of premise that this problem is based on. The last argument, that it is impossible to counterfeit birth

9 Isoc. 21.2–7 describes an Athenian, in unfortunate circumstances, who deposited money with someone to avoid the predations of the Thirty while he went into exile. For a view of banking that sees it as rather pervasive in Athenian society, see Cohen (1992).

10 Cf. Juvenal 13.15 and 60–62, in his lament over society's declining values, sarcastically observes that someone who actually returns a deposit to a friend is given great acclaim.

11 Cf. Isaeus 1.41, 4.12, 4.23, 7.2, 9.7–8. Cf. Thompson (1981) and Aristophanes *Wasps* 583–87.

but many wills have been revealed to be false, seems somewhat of a modification of the argument that while witnesses have been convicted of false testimony, no one has been revealed to have spoken falsely under torture (Is. 8.12; cf. 3.4–5), somewhat of a stock argument regarding torture.¹² Thompson (1981, 15) argues that an Athenian jury will accept a will if it is convinced that it accurately represents the wishes of the deceased, which seems somewhat to deny the premise.

The section is admittedly short, but there is no mention at all of the technical legal language that surrounded inheritance cases in Athens. There is no mention, for instance, of the *διαμαρτυρία* procedure by which testimony is given that estates are not open to disposition by a will because of a living heir, or the *δική ψευδομαρτυριῶν* that might follow, in which the judgment between birth and will took place through a trial for false testimony of the person who gave the *διαμαρτυρία*.

4 *Pr.* 29.4 & 8

Why does Poverty exist among the good people more than among the base? (4)

Why does Wealth in most cases exist more among the base than the fair? (8)¹³

Poverty (a divinity) occurs more among the good than the base. A very similar premise to that of Aristophanes' *Wealth*, as Robert Mayhew's notes in his Loeb *Problems* indicates.¹⁴ Aristophanes details what might occur if the god Wealth gained sight and so was attracted to good people—precisely the premise of 8, which seems the inverse of 4. The problem outlines various character motivations for Poverty, none of them involving blindness, but the penultimate word in 4 (*δυσίατον*, “incurable”) does suggest that some lack of health is present. Perhaps blindness is implied. It is interesting that the author thinks that these ideas, about wealth distribution, belong among problems of justice. Such a conception of distributive justice seems more modern.

The issue raised in 29.4 echoes several ideas that arise in the book's other problems: that association with Poverty leads to a change of behavior (10), a

¹² Cf. Isoc. 17.54, Is. 8.12, Dem. 30.37, Arist., *Rhet.* 1.15.1376a20–21; Mirhady (2007): 264–65.

¹³ Mayhew (2011a) translation.

¹⁴ Mayhew (2011a, 253 n. 5 and 255 n. 11). Ivánka (1935, 147) also points out the portrait of Poverty in Theognis 173–78.

concern about being treated well (i.e. with honor) and not with *hubris* (1; cf. 16), the treatment of females versus males (12), and, finally, (moral) choice (1, 16). The consistency of these interests among the problems suggests a common author for them.

5 *Pr.* 29.5

Despite textual problems, the gist of this chapter seems clear: Why in injustices of the same kind but differing size do the greater ones not occur more? The author cites examples from speech (minor insult vs. libel), betrayal (of a friend vs. a state), and theft (of an obol vs. a talent). The only explanation offered is that there are fewer instances of greater injustice because of a lack of opportunity or power (*ἀδυναμία*). The premise seems to be that the same sort of character commits both the small and the great injustice.

Arguments are made in Isocrates 20.3–8 about the punishment of escalating injustices, from insults through violence, that suggest that one might forestall violence by punishing an insult as if it were the actual violence. Isocrates also notes that in cases of temple robbery the penalty is death no matter what the size of the theft (20.6). He even suggests that people with the sort of characters that do serious wrongs be punished even before they have committed any (20.14). So the arguments about a lack of opportunity might be extended, but perhaps only for argument's sake, since the legal implications of punishing people based on their characters rather than what they have actually done would be enormous. This problem seems one for the sophists' lessons rather than an actual court.

6 *Pr.* 29.7

This chapter asks “Why is humanity, which most participates in education, the most unjust of all animals?” It seems to string together a series of persuasive identifications: education = reasoning (sc. calculation, *λογισμός*), reasoning = examination (*ἐξέτασις*) of pleasure and happiness (*ἡδονή*, *εὐδαιμονία*). Finally, one man's pleasure = injustice to another.¹⁵

The claim that humanity is “the most X” of animals seems very Aristotelian, though one might also think of Seneca's description of the human as a rational

¹⁵ I am grateful to Robert Mayhew, who points out *Pr.* 30.6 to me, another, similar claim about humanity.

animal (*Ep.* 41.8). One thinks, however, in particular of Aristotle's claims that humanity is the most mimetic (*Poet.* 4.1448b5–9), desires to know (*Metaph.* A.1.980a1), or is by nature political (*Pol.* 1.3.1253a2–4). Indeed, this problem seems an occasion for further meditation on the last claim: “in distinction from the other animals [the human] alone has perception (αἴσθησις) of good and bad and right and wrong and the other moral qualities, and it is partnership in these things that makes a household and a city-state” (1253a15–17). But unlike this text, Aristotle in the *Politics* says that human capacity for injustice is linked to the absence of law (1253a31–38). In that context law might be identified with an aspect of education (παιδεία). However, Aristotle elsewhere criticizes Socrates for his reliance on παιδεία rather than laws (*Pol.* 2.5.1263b35–40; cf. *Pl. Rep.* 491d–e). So it is difficult to know whether to locate the discussion with regard to Aristotle's “human is political” claim or with the debate with Plato on law vs. education. The claim that pleasure and happiness entail injustice, however, seems decidedly un-Aristotelian. And given the long influence of Platonic and Aristotelian writings, the similarity of these questions to the one entertained with regard to Plato and Aristotle should not lead us to conclude that they have to have been composed in the fourth century BC.

7 *Pr.* 29.9

The problem in 29.9, why it is more just to defend the dead than the living, seems part of an interest in defending the defenseless, like the women in 29.11. That the living can defend themselves seems the correct, if prosaic, answer. Lysias seems to touch squarely on the issue:

there has been no lack of zeal on my part in defense of the temples which these men have either sold or defiled by their presence; in defense of the city which they abased; on behalf of the arsenals, which they demolished; and on behalf of the dead, whom you were unable to protect (ἐπαμύναι) in life, and must therefore help in death. (12.99)

Lysias himself may be referring to Homer, who has Achilles bemoan his inability “to protect” Patroclus as he died (*Il.* 18.99). Achilles then goes out, of course, and does much “to defend” him in death. The paradox remains, however: one can “protect” the living, but it seems more usual to say that one “takes vengeance” (τιμωρεῖν) for the dead. The passages in Lysias and Homer are consistent in this regard. But what our text is referring to seems elusive.

8 *Pr. 29.10*

This chapter asks why association with others cannot promote health or strength, whereas it does promote a sense of justice, moderation, and goodness. The problem actually seems to concern health (cf. *Pr.* 7.4) and general ethical concerns more than justice specifically. Nevertheless, the emphasis on imitation (μίμησις) and habituation (ἐθισμός) seems thoroughly relevant to Aristotelian thinking on justice and ethics.¹⁶ The overlapping of issues of health, ethics, and justice certainly could explain a sort of misplacement of this chapter.

9 *Pr. 29.11*

The claim is made here that it is more terrible to kill a woman than a man although the male is by nature better than the female. The *Athenaion politieia* tells us nothing about the killing of women versus the killing of men, but it does note that alleged killers of slaves, resident aliens, and foreigners are tried at the Palladium, where those accused of involuntary homicide and plotting (homicide) are also tried (*Ath. Po.* 57.3). That is, they are not tried at the Areopagus with the accused voluntary killers of Athenian citizens. The suggestion seems to be that for the Athenians the killing of a non-citizen is less serious. Athenian law appears therefore to make no distinction with regard to the gender of the victim even though it does acknowledge other status distinctions. On the other hand, there was a law that if a man killed another who was “on top of” (ἐπί) a woman who was part of his household (Dem. 23.53), the man could make the defense of lawful homicide. Such a law gives some indication that there were special protections for women in Athenian law. Again, the problem seems to take on an issue of social opprobrium associated with the law rather than a legal question itself.¹⁷

In committing herself to be sacrificed to Artemis and so assure the success of the Greek campaign against Troy, Iphigenia strikingly makes exactly the opposite point in Euripides’ *Iphigenia at Aulis*: “Better a single man should see the light than a myriad of women” (1394). Of course Iphigenia’s argument is

16 For a recent treatment of this issue, see Lockwood (2013).

17 Robert Mayhew helpfully suggests comparison to *Pol.* 1.13.1260a15–23, where Aristotle notes the different sorts ἀρετῇ that men and women possess. Aristotle does not go on there, however, to discuss killing men vs. killing women.

meant to be paradoxical, an indication of her own heroism in offering herself. So in that sense it confirms the ideology of our text, which suggests that women's lives need greater protection than men's.¹⁸

10 *Pr. 29.12*

Why is the defendant positioned on the right? There is no other evidence for where the two sides stood in relation to each other in the Athenian courts. Several passages suggest that at Athens there was a platform (βῆμα) where the speaking litigant stood as he spoke; the other litigant sat.¹⁹ Some passages, even from the same sources, suggest that there were two platforms.²⁰ In his *Against Timarchus*, Aeschines, who is the prosecutor, suggests that the herald (also a guard?) stood beside him: "If this herald here, the one standing beside me now, asked you the proclamation prescribed by law" (1.79 = Boegehold 252). In our passage it seems that if the defendant is on the right, as the judges look on, then having the guard on the right side of the defendant, as the defendant stood (to his left as the judges look on) would put the guard between the litigants. But that is only one possible reading of this text, the significance of which remains elusive.

18 Flashar (1962, 707) agrees with earlier editors that ἢ διότι ἀσθενέστερον, ὥστε ἐλάττω ἀδικεῖ ("Is it because she is weaker, so that she does less injustice?") makes no sense. The earlier editors took issue with ἐλάττω (μᾶλλον Bonitz, μείζω Ross); Flashar prefers to change ἀδικεῖ to ἀμύνεσθαι ("less able to defend herself"). But like Mayhew (2011a, 256–57) I would prefer to make sense of the manuscript reading. The end of 29.5, admittedly not altogether clear itself, seems to offer a parallel: ἀπὸ μείζονος ἀδικίας ἔνια ἐλάττω ἐστὶ δι' ἀδυναμίαν ("Some things that come from greater injustice are less owing to a lack of power"). The woman is weaker, i.e. less able, so she does less injustice, and is thus less culpable and less deserving of death. The author seems interested in the human capacity to do injustice, as in 29.7 as well.

19 The evidence has been collected in Boegehold (1995). The following texts suggest a single platform: Aesch. 2.59 = Boegehold 227, Aesch. 3.56 & 165 = Boegehold 229 & 230, Aesch. 3.257 = Boegehold 232; Suda, s.v. *bema* = Boegehold 244. On the Areopagus rather than in the agora, Pausanias (1.28.5) reports seeing platforms of unworked stone where the defendants and prosecutors stood in homicide trials. Cf. Theophrastus 646 FHS&G.

20 Aesch. 3.207 = Boegehold 231, Schol. Dem. 19.120 = Boegehold 239, Dem. 48.31 = Boegehold 241. I am grateful for an email exchange with L. Bablitz, whose 2007 book discusses spatial aspects of the Roman courts. She could see no resonance between this text and the Roman evidence.

11 *Pr. 29.13 & 15*

Mayhew (201b) is a recent thoughtful account of 29.13, so despite its length I shall limit myself to just a few comments on the problem of why a defendant wins when the judges' votes are tied. In Greek classical literature, the tied votes of the Areopagus in Orestes' trial receive repeated notice,²¹ the Attic orators also note the practice,²² and it is recorded in the *Athenaion politeia* (69.1). The *Rhetoric to Alexander* similarly points out the rhetorical advantages to be gained from the fact both that the judges are sworn to hear out both sides and that a tied vote goes to the defendant (18.6–7). The close connection of these two recommended arguments in the *Rhetoric to Alexander* suggests their close connection throughout these sources, namely, that the literary fascination with tied votes was really meant to indicate a fundamental ideology of fairness in the Athenian courts: the courts considered both sides equally and sided, if ever, such as in the rare case of tied votes, with mercy (συγγνώμη) and the defendant. But a tie must have been fairly rare in the classical Athenian law courts. The number of judges was counted in multiples of two hundred (in private cases, *Ath.Po.* 53.3) and five hundred (for public cases) and in the classical period an extra judge (the magistrate, I believe; cf. *Ath.Po.* 66.1) was added, creating odd numbers, 201, 401, 501, etc., seemingly for the purpose of avoiding ties.

The author points out numerous claimed disadvantages for the defendant, all of which are to be remedied, or at least mitigated, by having the defendant win a tie vote. There have yet to be studies done on the known votes of Athenian trials. In modern criminal trials there is an insistence on unanimity of the jurors if the defendant is to be convicted. In Athens, there also seems often to have been a broad consensus among the judges in many cases. There was a penalty against the prosecutors who failed to win twenty percent of the votes, something Socrates refers to after hearing the vote that convicted him (*Apol.* 36a): if each of his three prosecutors had got only the third of the votes that he ostensibly had won, he would have been penalized for winning fewer than twenty percent of the votes. The penalty against such an egregiously unsuccessful prosecutor seems unlikely to have been incurred that often; it would otherwise have become quite a discouragement to prosecuting cases. Socrates' arithmetic gymnastics seem worthy of the sophists, who likely

21 Aeschylus, *Eumenides* 742, 752–53; Euripides, *Electra* 1265–69, *Iphigenia among the Taurians* 1469–72; Aristophanes, *Frogs* 684–85.

22 Antiphon 5.51; Aeschines 3.252.

devoted considerable time to teasing out such implications of the judicial system, including the possibility of tied votes. The reference to it in the *Rhetoric to Alexander* seems such an instance.

It is worthwhile to list the subsections in 29.13, and then discuss each one in a bit more detail, saying a few words about 29.15 as well:

- a. 13.951a21–37: defendant unprepared, fearful, in greater danger
- b. 13.951a37–b9: better to release the guilty than condemn the innocent
- c. 13.951b9–19: side with the possessor
- d. 13.951b19–25: unjust conviction may be irremediable
- e. 13.951b25–33: unjust prosecution entails more forethought than many prosecutable acts
- f. 13.951b33–952a2: we do not punish slaves if we are ambivalent about their guilt
- g. 13.952a2–10: unjust prosecution is more often intentional
- h. 13.952a10–16: unjust prosecution is more obvious
- i. 15.952b35–953a2: the defendant has had nothing to do with the prosecutor

a **13.951a21–37**

In Athens, legal cases went through several stages before they reached a law court (δικαστήριον) where a tied vote might occur. Many forensic speeches describe lengthy series of disagreements and attempts at settlement that occurred between the time of the disputed act and the trial. Attempts are made at one-on-one settlement. Then a private arbitrator is often sought out, and perhaps even engaged. Challenges (προκλήσεις) are often made to settle the dispute on the basis of a sworn oath or the torture of a slave. At some point, the relevant magistrate is visited and a formal charge is made after a question and answer session (ἀνάκρισις) with the magistrate. In many cases a public arbitration takes place before a well-seasoned citizen chosen by lot, and only if his arbitration decision is rejected does the case finally come to trial. These lengthy processes make it highly unlikely that a defendant would not know what sorts of arguments the prosecutor was bringing forward at trial. In fact, the speeches are highly reliant on evidence such as witness testimony and the texts of challenges to oaths and slave torture, and the *Athenaion politeia* makes clear that only those pieces of such evidence could be used at the trial that had already been presented before the public arbitrator (53.3). That is, at Athens the arguments of both sides are likely to have been fully disclosed to the other well before the trial. Our author seems oblivious to this fact. However, this disclosure would seem to make the defendant's unpreparedness highly unlikely.

There was, moreover, the procedure of *παραγραφή*, the counter-charge that a suit was inadmissible. The result of the *παραγραφή* was that in some cases the defendant even spoke first.

b *13.951a37–b9*

Antiphon 5 is a defendant's speech in a trial resulting from the death of an Athenian citizen. But the charge is not homicide but only "wrongdoing" (*κακούργημα*), which nevertheless could entail capital punishment at the discretion of the court. The speaker invokes several of the arguments that occur in this problem, such as that his speaking is inhibited by his being in danger (Ant. 5.7). But the possibility of being retried seems to cut both ways for him: first he complains that even if acquitted he could be charged again for homicide (5.16); later he reassures the judges that, if wrongly acquitted, he can still be charged again on the right charge, that is, homicide, and warns against them making an immediate, irremediable verdict (5.85, 91).

Our author warns that an incorrect conviction would be somewhat like mistaking a free man for a slave, hardly something that seems irremediable. But note that the Old Oligarch makes a similar warning not to punish slaves on the street for fear of actually striking an Athenian citizen ([Xen.] *Ath.* 1.10). The concern about being treated like a slave seems very strong in both contexts.

c *13.951b9–19*

The modern saying "possession is nine-tenths of the law" is certainly an exaggeration, but it seems somewhat echoed in this passage. In a land dispute the possessor does normally retain disputed property until a decisive verdict goes against him. That seems largely a practical matter, so long as the dispute does not drag on unduly. The alternative might involve displacing people twice instead of only once. But is it an appropriate analogue to the situation of the tied votes? The author says that the possessor should not surrender the property to the accuser "immediately" (*εὐθύς*), and that seems the key word. The property dispute is about timing, not tied votes.

Nevertheless, at the end of this section the author does seem coincidentally to hit upon the most correct explanation for why tied votes go to the defendant: the lawgiver leaves things as they are when the prosecutor does not achieve a superiority of votes. In Athens, a prosecution was somewhat like a proposal in the Assembly. In order for a proposal to pass, a majority of the citizens who attended the Assembly had to approve the proposal, the essence of majoritarian democracy. Likewise, a majority of the judges had to support the prosecution proposal.

d 13.951b19–25

This passage echoes some of the sentiments in b above, where the passages of Antiphon 5 seem relevant. But this passage raises two additional thoughts: first, that someone wrongfully acquitted on a capital charge who does no further wrong does not harm society very much; and second, if he does do further wrong he can be punished both on a new charge and on the old.

Nowhere in book 29 is the issue of pollution (μίσμα) raised, even where, as here with the trial over a capital charge, the suggestion is that the offense might have been homicide. In Athens, pollution plays a large role in discussions of homicide. The presence of a killer in the city, like the presence of Oedipus in Thebes in Sophocles' play, was thought to do harm even if he never did another wrong.²³ That would make the possibility that is raised here, of allowing the falsely acquitted killer to continue living in the city, create some unease.

e 13.951b25–33

This section begins with what seems to be a riddle: "is it characteristic of a more unjust man to commit injustices for which he is less likely to be charged unjustly?" (951a26–27). The author then notes that many injustices are not done out of forethought (προνοία), whereas unjust prosecutions stem "for the most part" out of forethought. He then imagines a scenario in which equal votes are cast both for the proposition that the defendant has committed an injustice and for the proposition that the prosecutor has led an unjust prosecution. Finally, he concludes that because the unjust prosecutor is more base than the unjust defendant (presumably because of his more frequent forethought), the lawgiver gives the victory (in a tied vote) to the defendant. This passage displays a fantastic series of feats of mental agility, but they seem quite specious. Further reflection on the same issues appears to come in (g) below.

f 13.951b33–952a2

The author argues that there is hesitancy to punish slaves unless there is certainty that they have done wrong. That is not the picture of master-slave relations that we get from Aristophanes and the Attic orators, where flogging appears frequent and offers to torture slaves for information are common. Again, a comparison is made between tied votes and an avoidance of precipitous judgments (see [c] above). The punishment of the slave should not be "immediate" (εὐθύς), but only following further examination.

23 Arnaoutoglou (1993) argues that though pollution is much discussed, it has a minimal role in Athenian law *per se*. Harris (2010), however, argues convincingly for pollution's role.

g 13.952a2–10

This section appears to follow (e) quite closely, but in clearer language. Here the unjust prosecutor is described, in language that is familiar from classical forensic oratory, as performing sycophancy (συκοφαντῶν), that is, malicious prosecution. Defendants in the Athenian courts frequently charge their prosecutors with being sycophants, and Aristophanes has great fun ridiculing them as one of the worst aspects of the Athenian democracy.²⁴

h 13.952a10–16

The author argues that because an unjust prosecutor does not escape a defendant's notice when he prosecutes, the greater obviousness of his prosecution makes him more culpable than a prosecuted wrongdoer who might have hoped to escape notice. It seems an argument that could easily cut the other way: one might argue that the attempt to be secretive was more culpable. At any rate, it seems completely unrelated to a tied vote of the jury.

i 15.952b35–953a2

The thought sequence in 15 is elusive:

ὁ φεύγων ὑπὸ τοῦ διώκοντος οὐθὲν πέπονθεν, ἀλλ' ἐν τοῖς ἴσοις αὐτῷ ἤδη ἔμελλε νικᾶν.

The defendant has not been affected by the prosecutor, but in an equal position with him he was already going to win.

The implication of οὐθὲν πέπονθεν is unclear. The translation “has not been affected” is the most straightforward. The second part of the sentence seems, however, largely just to echo the problem itself: ἐὰν ἴσαι γένωνται ψῆφοι τοῖς ἀντιδίκοις, ὁ φεύγων νικᾷ (“if the votes are equal for the litigants, the defendant wins.”) My sense is that the implication of οὐθὲν πέπονθεν is that the defendant “has had nothing to do with” the prosecutor, so unless the prosecutor had pursued the prosecution—and so put the defendant at a supposed disadvantage—he would have lost a contest between them. Admittedly, the meaning “has had nothing to do with” is not quite supported by LSJ (s.v. πάσχω III.4).²⁵

24 Osborne (1990) and Harvey (1990) carry on an interesting debate about the nature of sycophancy.

25 Cf. also 29.26, where acting with *hubris* is described as an ἀνθρώπινον πάθος, which suggests that πάθος and πάσχω might be understood actively.

12 *Pr.* 29.14

Why is the punishment death if someone steals from a bathhouse or a palaestra or a market or any such place, but he pays back twice the value of the object stolen from a private house? (952a17–20)

Uniquely within this book, the problem seems clearly traceable back to Athenian legislation that is reported by an orator:

Or suppose someone snatches a cloak, or an oil-flask, or any such trifle, from the Lyceum, or the Academy, or Cynosarges,²⁶ or any utensil from the gymnasia or the harbors, above the value of ten drachmas, for such thefts also Solon enacted death as the penalty. But if a man is convicted on a private prosecution for theft, while the normal penalty is double reparation, the court is empowered to add to the fine the extra penalty of imprisonment for five days and as many nights, so that everyone may see the thief in jail. (Dem. 24.114)

Solon's legislation clearly did not name the Lyceum, the Academy, or Cynosarges. They are specific locations whose inclusion increases the vividness of Demosthenes' description. But our text names a bathhouse (repeatedly) and *palaestra* instead of gymnasia and harbors (cf. [f] below).²⁷ Baths and bathing were an overwhelmingly Roman cultural phenomenon, not Greek, so the cultural context of our text seems quite different from Demosthenes'. As F. Yegül points out, moreover, "petty theft in public baths was a common though much despised occurrence" (1994, 34). There seems no suggestion that the death penalty was a punishment foreseen for such petty theft, and in fact Demosthenes' ten drachmas is hardly petty value for a stolen object.

We know of legislation against stealing from a temple from Isocrates 20.6 (cf. Lyc. 1.65–66), which also invoked the death penalty. There the religious significance of the theft seems to have created the need for the death penalty, despite the sometimes low value of what was stolen. But the variety of places mentioned in our text and in Demosthenes, from bathhouse to gymnasia, markets, and harbors, seems to preclude any religious association. Demosthenes sets the bar at ten drachmas, which seems a sizeable amount to carry if one is

26 While the Lyceum and Cynosarges were both sites of gymnasia before Aristotle and Antisthenes the Cynic became associated with them, the Academy was a sacred grove of olive trees dedicated to Athena.

27 "Harbor" in this sense is really just another marketplace. Cf. LSJ s.v. λιμήν A.III.

off to exercise at the gymnasia. Many things about this problem, and about the legislation that Demosthenes ascribes to Solon, defy explanation.

As in 29.13, multiple explanations are offered in 14:

- a. 952a20–30: private houses can be guarded
- b. 952a30–952b4: homeowners admit whom they want
- c. 952b4–13: public thieves have no concern for their reputations
- d. 952b13–21: public theft affects the city's reputation
- e. 952b21–26: public theft (of clothing) will inflict the shame of public nakedness
- f. 952b26–35: many very similar things have been legislated: slandering a public official is *hubris* against the city

a 952a20–30

Despite what our text says, there was Athenian legislation that allowed that if a man discovered a thief in his house at night, he was not liable if the thief was killed (Dem. 24.113; cf. 23.60). If the theft was not discovered until later, then of course a private suit could be pursued. Our text emphasizes the various forms of security offered by a house: its walls, a key, and vigilant servants. But it argues that in common areas such as a bathhouse, one had to keep an eye on one's belongings oneself. Martial points out, however, the obvious security precaution: have a slave guard your toga at the baths (12.70.1–4). This problem seems to delve into an area that was not generally regarded as a serious problem, even if it was common and annoying.

b 952a30–952b4

As we see elsewhere in this book, the author takes an interest in the choices made either in mitigating or aggravating responsibility. Here the choice of the homeowner to admit the thief is supposed to mitigate the thief's responsibility. One can imagine how it might have done the opposite: a homeowner generally admits friends, so if that friend steals, he both commits theft and betrays the friendship, as in 2 above, where a deposit with a friend that is stolen likewise betrays the friendship as well as the financial trust.

c 952b4–13

If as seems likely this problem does owe its origin to the passage in Demosthenes, or at any rate to the legislation to which that passage refers, there seems another disconnect in this explanation. Here it is assumed that the thief who steals in a public place, such as a bathhouse, is immediately apprehended and his crime manifest. It is even assumed that the thief does not want to appear

honest. Those seem big assumptions. The ease with which theft from a bathhouse can be accomplished suggests that the thief could often get away with it. In the Demosthenes passage, publicity surrounding a theft is not associated with the public theft from a gymnasium but with private theft: the thief can be put on display for five days to publicize his crime. It seems as if in the retelling of the story, the use of publicity as a form of punishment shifted from the private theft to the public theft.

d 952b13–21

The text moves from bathhouses to the “most public assemblies and meetings” and raises the issue of how “offenses” in those contexts bring shame to a city. Petty theft from a bathhouse seems quite far removed.

e 952b21–26

Now the text moves back to the contrast between bathhouses and private homes and raises the issue of the potential public nakedness of the man whose clothing is stolen from a bathhouse. The possibility of borrowing clothing is not considered. And the suggestion is clear that causing public nakedness in this way is deserving of the death penalty, which hardly seems plausible.

f 952b26–35

This passage seems to repeat the point in d above associating stealing from bathhouses now with the specific offense of maligning an official. Again, the bathhouse has disappeared and in its stead the “harbor” appears, in this sense clearly equivalent to an agora.

13 *Pr.* 29.16

This problem may be an echo of 29.14, but it introduces another element in its contrast with *hubris*. In Athens *hubris* was indeed dealt with through a charge, the γραφή ὑβρεως, that was τιμητός, which meant that after a vote for conviction there had to be a second vote, to choose between the alternative penalties proposed by the prosecutor and defense. But that did not imply, as our author suggests, that such a charge was taken less seriously. An act of *hubris*, like many other offenses, might be more or less severe, and so it was up to the judges to decide upon the severity of the punishment.

More interesting is the admission that acting with *hubris* is part of the human experience, an ἀνθρώπινον πάθος, in which all share more or less. That

certainly seems an understanding of *hubris* that goes beyond that of the fourth century, where it seems only to apply to forms of egregious behavior. Our text then offers the explanation that theft involves a moral choice (προέλοιτο) to commit *hubris*, which suggests that the common human form of *hubris* may also not involve moral choice. The philosophical implications could be very interesting. Again it is regrettable that the thinking is not fleshed out.

The lack of scholarship devoted to the *Problems* up to now, and to book 29 in particular, has necessitated a cursory review of the book's possible historical background. Despite its literary context among the works of Aristotle and his fourth-century BC historical context, its thinking seems to span a wide time frame, taking its origins even before Aristotle in sophistic thinking that appears similar to that in the forensic speeches of Antiphon, Isocrates, and Isaeus. Although it gives precious few clues to its precise time and place of composition, its references to bath culture in 29.14 seem well after the time of Aristotle and to reflect the influence of Roman culture as well as Greek.

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Black Bile as the Cause of Human Accomplishments and Behaviors in *Pr.* 30.1: Is the Concept Aristotelian?

Eckart Schütrumpf

1 Explanation of the Working of Black Bile

Pr. 30.1 offers a physiological explanation of the effects of black bile. These effects differ vastly depending on its amount or the temperatures it is receptive of.¹ The main analytical concept presented here to account for the cause of the variety of effects is that of “mixture” (*krâsis*) which refers exclusively to the temperature of black bile.² The most remarkable effect it can have is that of producing exceptional men in the areas of philosophy, politics, poetry, and the arts: “if men are mixed in a certain way they are exceptional (*perittoî*)” (954b27f.). *Pr.* 30.1 actually starts with a question that refers to this effect of black bile: “Why, as can be shown, are all exceptional men melancholic?”

This paper attempts to identify more clearly than has been done so far³ the specific condition of black bile that produces extraordinary men. For this purpose the argumentative strategy followed in this chapter, which has received almost no attention, will be analyzed. Finally I will argue that the author of *Pr.* 30.1 is at best superficially familiar with Aristotle and that *Pr.* 30.1 moves away from Aristotelian concepts on the formation of character qualities.

The physiological explanations of the different effects of black bile⁴ leave the impression that the causes for the working of black bile and its results as presented here had not been widely accepted. This state of affairs in turn sug-

1 See *Pr.* 30.1.954a21 ff. for a description of various stages of emotional changes due to temperature of black bile; see 954b20ff. on the various stages due to amount of black bile.

2 953a30; b23; b 27; 954a13; a29f.; a32; a38; b7f.; b25; b28; b33f.; 955a14f.; a34; a36.

3 Mûri (1953); Klibansky et al. (1964); Flashar (1966) and (1975); Tellenbach (1983); Theunissen (1996); van der Eijk (1990) and (2005); Centrone (2011).

4 That is: exclusively of black bile; there is no consideration of the relationship of black bile to other humors as Klibansky et al. (1964, 29) assume when they mention the case of the “quantitative preponderance of the melancholy humour over the others,” cf. 30; Flashar (1966, 62, 67). Ficino had established ratios of humors, see Klibansky et al. (1964, 32 n. 63).

gests the need for an extensive use of analogies, “examples” (*epi paradeigmatos*, 953a33). As part of employing analogies, the author writes in this chapter a lot about wine or sex⁵ in order to show that in a similar way or even “for the same reason” (953b21) black bile is the cause of so many changes of character or “personality” (*êthos*).⁶ A reader who was not a medical expert could be assumed to be familiar with the experiences referred to in these analogies so that he would accept the new insights about the working of black bile that are based on, or illustrated by, these analogies. The author sees and describes humans in a great variety of moods and behaviors that are the result of the temperature and amount of black bile.⁷

The effects of drinking wine are used as an analogy for the working of black bile because wine adds from outside heat in a porous stuff which is similar to black bile (955a35f.) and has the same effects.⁸ Forms of behavior that are caused by wine and which are peculiar to melancholic persons are “being angry, caring, prone to pity, aggressive” (954a36–39). However, the addition of substances to one’s body from outside can do more than serve as an analogy for the effect of black bile; there are things taken in and digested that can change directly the condition of black bile (cf. 955a18–22), e.g. some food which can lead to some sort of melancholic sickness (954a26–28). Those who are already melancholic are adversely affected by wine whose inherent heat extinguishes “the natural heat” of melancholic persons, and this condition can lead to suicide (954b36–39).

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- 5 The analogy with wine: 953a33–954a6. For the universal experience see 955a1 “all are keen to drink to the state of inebriation because this sets them into a cheerful mood.” At Arist. *EN* 7.15.1154b10ff. the remark about melancholic persons follows one on youth and being drunk; inebriation is, however, not used by Aristotle as an analogy to melancholy, contra van der Eijk (2005, 157 n. 66). Consumption of wine and becoming amorous are related because wine causes this desire: *Pr.* 30.1. 953b15ff. And for men feeling good or bad after sex is referred to the amount of heat and *pneuma* emitted. Other analogies are water (954a16); stone (a18); coal (a19).
 - 6 953b20–22; 954a28–30: they show a great variety of different attitudes, each according to the different mixture; 955a32–35. Müri (1953, 26) suggests “Persönlichkeit” as translation of *êthos* which is correct for permanent character traits, e.g. 954b21, but not for a passing state of mind, cf. 953b7.
 - 7 The analogy with wine shows that the bodily constitution of a person determines his or her mental state and produces a variety of emotional and mental conditions that might even be at odds with one another, cf. van der Eijk (2005, 157f.). For representatives of this medical concept in earlier texts and the Hippocratic Corpus see Müri (1953, 27–38).
 - 8 The same effects can be produced by different causes, cf. 954a37: religious frenzy can be caused by a certain mixture of black bile or an illness.

Moreover, external *situations* one finds oneself confronted with can be additional factors that contribute to a change in the condition of black bile and accordingly in one's mood: the realization of something frightening is said to "chance upon" a certain mixture of black bile.⁹ If black bile is cold this temperature prepared already for a fearful response to alarming news; receiving such news only reinforces the inherent prevailing natural tendency: they have "a chilling effect"¹⁰ and turn a person into a coward.¹¹ However, under different circumstances there are positive outcomes of frightening situations possible: "When (the mixture of black bile) is hot, fear transposes someone into a moderate state and leaves him unaffected" (954b14f.).

At *Pr.* 30.1 emotions are not always and not necessarily a result of the combination of external stimuli on the one hand and internal conditions of the black bile on the other; this chapter explicitly denies that daily mood swings must be a response to external stimuli: "... the same is true for daily feelings of lack of initiative; because often we are in such a state that we suffer pain but we couldn't tell why; at other times we are cheerful, but it is not clear for what reason" (954b15–18). By reference to temperature-changes of black bile the author supplies the scientific explanation of something the persons affected cannot explain themselves. By connecting the explanations of so different experiences as indifference in frightening situations and daily mood swings by the words "in a similar way" (954b15) the text indicates the strength of this physiological method that provides an explanation of such diverse experiences as those described here.

2 Structure of the Treatise and Organization of the Material

The treatise does not deal in a systematic manner with the conditions of black bile.¹² Thus it is in the context of a specific, rather extreme effect of hot black bile (madness) that we learn about its location "in close vicinity to the seat of the mind" (954a34).¹³ And in a different context, when using the

9 954b1f. "if it chances upon (*tuchêi*) a mixture that is rather cold."

10 So as well *Pr.* 8.20.889a23–25. On the change of temperature (here: warming) caused by what one hears: see *Hp. Morb.* 1.23.

11 954b10–14: the observation that people shiver when in extreme states of fear is taken as a confirmation of the explanation that cold temperature makes men fearful. Cold air makes men shiver: *Pr.* 8.8.877b37—not the cold temperature of black bile. See Flashar (1975, 721 n. on 954b1ff.).

12 Flashar (1966, 64).

13 Cf. for the historical context van der Eijk (2005), ch. 4: "The heart, the brain, the blood and the pneuma: Hippocrates, Diocles and Aristotle on the location of cognitive processes."

analogy with the working of wine, we read: “it is the heat of the region with which we think and have expectations that makes us cheerful” (954b38–955a1). This approach that reveals a fact about black bile, its location, only in the context of a particular condition leaves it open whether black bile is always located close to the mind or only at elevated temperatures so that it could be found in men of a different constitution in other places as well,¹⁴ in other words: is under the described circumstances (elevated temperature) a universally valid condition (location of black bile) particularly effective, or could under different, less intense circumstances other possibilities for its location be assumed and could a different location explain different effects? We do not learn this. Similarly, while some remarks suggest that black bile is highly unstable, others indicate that a certain condition of black bile is part of an individual’s nature; however, the text does not explain in which way a more permanent individual constitution allows fluctuations.¹⁵

In spite of this obvious absence of a systematical treatment of the subjects covered one could roughly make out the following structure:

After the introductory remarks on exceptional men (953a10–32), *Pr.* 30.1 proceeds with an extensive use of analogies with wine and sex in order to explain the material substance (*pneuma*) and working of black bile (953a32–954a11)—it is a sign of the lack of systematical treatment that close to the very end of the treatise the various conditions of wine or sperm are again referred to.¹⁶ In the initial section temperature is only marginally referred to.¹⁷ A clear order in the presentation of the arguments that follow this introductory section (954a11ff.) is difficult to detect. Its flow could be described as meandering or could be compared with medical imaging of a highly irregular heartbeat, showing both the low and top extremes and the many possibilities in-between. If there is any principle in the organization of the arguments then it is that

14 van der Eijk (2005, 160), referring to *Somn.* 3.457a33. Cf. *Pr.* 27.4.948a13f. “Heat is located in the area of the chest.” Cf. 8.20.889a15–25 where “heat deep within” is contrasted with heat in “the places of the surface.”

15 The specific condition of black bile is unstable: 955a29ff. It is part of one’s nature: 954a28–30. Müri (1953) stresses the fluctuations of behavior.

16 The objective is here to explain the way one’s temperature is affected after having wine or sex: men experience suicidal tendencies after wine and feel differently after sex depending on whether they are relieved or cool down: 955a11–26.

17 953b1: cold is the condition one starts with when drinking wine; b20–22: for the same reason wine and black bile produce a great variety of behaviors since they are determined by heat; b28–30.

of proceeding by introducing contrasts to whatever has been said¹⁸ and moving forward by presenting alternatives, often opposites, to the conditions just mentioned while always returning to extreme states at both ends of the temperature scale.¹⁹ The different stages considered in this non-linear manner of proceeding that lists alternatives²⁰ can be marked by rather monotonous repetitions of key phrases.²¹

The intensive states are the focus of this treatise from the beginning where the statement that all extraordinary men are melancholic is immediately qualified by the remark: “and some to such a degree that they were overcome by illnesses that were caused by black bile” (953a12f.). To these extreme conditions the argument returns all the time whereas the less severe states are included to show that there exists in ordinary people a weaker form of some of the extreme experiences like utter despondency with suicidal tendencies from which only “excessively melancholic men” suffer. Thus the extreme states of despondency are contrasted with the daily gloominess or dejection that is expressed by the same term (*athumia*).²² The intensive effects of a great amount of black bile at very low or hot temperatures are the extreme scenario besides which there exist more common and moderate experiences. To such quite common

18 Cf. 954a21 (cold), a 24 (very hot); a30f. (cold), a31f. (very hot), a39 (reduced heat); b24 (middle), b26 (great amount).

19 At 954a21ff. the effects of a large amount of black bile at both very hot and cold temperatures are described. After discussing a medium temperature and a small amount of black bile the text returns at b25ff. to the description of the effects of a large amount of black bile. Cf. Müri (1953, 23): “the phenomena are discussed repeatedly” (“Die Phänomene werden wiederholt besprochen . . .”); Flashar (1966, 64).

20 One needs to note that the Spartan Lysander is introduced as another example not of being extraordinary but of the fact that excessive black bile can cause illnesses (953a19–21), and one has to assume what is not expressed that he belonged to the extraordinary men; the three philosophers are added “among those of later times” (a26–28) without a verb that would indicate whether they were “afflicted in a similar way” (*homoiopatheis*, a26) as those listed before or whether “they were manifestly melancholic” which is the overall topic, as is more likely. This incomplete sentence is just one of the many signs of the less than perfect reworking of the original by the ancient editor of the *Problemata*. It reveals the argumentative strategy of listing examples in a stereotypical fashion.

21 *Tois men oun* 954a26; *hosois de* a28; *hosois men* a30; *hosois de* a31; *hosois d’* a39; b20; *hosois men oun* 955a7; *hosois de* a11.

22 *athumiai ischurai* 954b31, contrast simple, modest *athumiai* b15. Differently Theunissen (1996, 15): “ein Sammelbecken alltäglicher Indifferenzgefühle” which he contrasts with “*dusthumia*, der depressiven Mißstimmung,” however, *athumia* can lead to suicide: 955a8. The areas in which men can be exceptional (953a11) or just above average (954b2–4) are the same.

occurrences the author refers, however, only incidentally so that the intense states remain the center of the scientific interest of this chapter while not losing sight of the larger spectrum of related, but less extreme experiences.

After the use of analogies (953a33–954a6), the main part begins (954a11) by identifying the topic of the inquiry as it was initially planned,²³ namely “that the fluid of black bile is mixed already in the nature.”²⁴ Except for the introductory sentence, in *Pr.* 30.1 only in this later passage the subject matter of the treatise is explicitly described. This description of the subject matter is broader than the question of the introductory sentence and fits the actual treatment of the topics found in this chapter better.

The text identifies here the mixture of black bile that exists immediately in one’s nature as one “of hot and cold” (954a13, cf. b33)—the aspect that the mixture is one of temperatures was of very little importance in the introductory part.²⁵ However, when moving from this general principle to the discussion of specific conditions two facts need to be noticed which narrow the meaning of the terms that had been introduced here. First, for all practical purposes, there is never a particular condition described as a mixture of the two temperatures, “of hot and cold,” with various degrees distinguished according to the preponderance of the one or the other in the mixture. Furthermore, and as consequence of the first approach, a ratio of the *mixture* is never determined, but black bile or its mixture is always described as *either* (very) cold *or* (very) hot,²⁶ and only once as middle (954b1) or “moderate” (b14)—using the analogy employed so often in *Pr.* 30.1: wine mixed with water would be described not from the ratio of the two ingredients but from the result as “strong” or “diluted.”²⁷

Related to the last observation and equally important for the understanding of the concept of black bile is the fact that, after identifying the mixture of

23 *proheilometha*, 954a11—for this word used to identify the subject matter of a philosophical treatise, cf. Arist. *Pol.* 2.1.1260b27 *prohairoumetha*.

24 The three elements of the reference at 954a11–13 to the introductory section are “melancholic,” “nature” (953a15; a32) and “mixture” (a30). Given this connection to the beginning of the chapter, it is irrelevant that 954a13 “ties in with” 953b22 (van der Eijk 2005, 158).

25 See above n. 17 for the rare exceptions.

26 Black bile or its mixture is cold: 954a21; a31; is “very cold”: 955a31; “when the mixture is rather (*mállon*) cold”, 954b11; b33f.; 955a13; “fear cools down”, 954b13; “men are cold, old age is cooling down”, 955a17f.; “men are hot” 955a17; black bile or its mixture is “rather (*mállon*) hot”, 954b14; 955a15; is excessively hot: 954a24; a32; “natural heat” 954b39; “excessive heat”, 954a39; 955a26. It is not completely correct when van der Eijk (2005, 158) writes: “Those in whom cold predominates . . .” referring to 954a30 where the text reads: “Those in whom cold is present (*enhuparchei*) . . .”

27 “Mixture” ultimately indicates a state in which one temperature dominates.

hot and cold as the general principle that accounts for the different effects of black bile, in the discussion of specific conditions the focus is on the extreme forms of temperature.²⁸ This approach makes sense since the description of extreme situations can make the explanation of any issue clearer. Thus, when Plato in *Republic* sets out to develop his view of justice Glaucon suggests that one contrasts *the most just* and *the most unjust man* and goes then to *extreme justice and injustice*²⁹ in order to gain clarity over the issue that is being investigated. Apart from the fact that such a method of explaining a topic in its extreme form is a convincing strategy for any argument, at *Pr.* 30.1 the focus on the extreme conditions of black bile might be due to the fact that the cause for the existence of exceptional men was to be given.

The first conditions to be discussed after the general principle of mixture had been stated are, as was pointed out, the effects of a large amount of black bile³⁰ both at very low and hot temperatures; the effects are of a mental or emotional nature and include severe bodily ills like the breaking up of ulcers (954a21–26)—in mentioning this effect the text picks up the discussion from the beginning of the treatise where this effect had been mentioned twice as connected with the melancholic state of exceptional men (953a18; a20). These excessively severe results are in turn *contrasted* with conditions under which one temperature leans towards the middle (954a39f.; b14f.). This moderate stage is the foil³¹ for yet another account of effects a very large amount of black bile (b25ff.) can produce: men who possess it are “excessively melancholic.” However, if they possess it “in a certain mixture” they are exceptional (b27f.). Here the condition of extraordinary men which this treatise wanted to explain

28 See above p. 361f. After 954a13: (nature) “is a mixture of hot and cold” (*thermou gar kai psuchrou krâsis estin*) follows at a14 “for this reason black bile can become both very hot and very cold” (*kai thermotaton kai psuchrotaton*). Cf. 955a31f.: “it becomes very cold and hot.”

29 360e, cf. 361a4f. *eschatê adikia*; d2 *eis to eschaton elêluthotes, ho men dikaiosunês, ho de adikias*.

30 I understand, with Hett (1936), van der Eijk (2005, 158 n. 69) and (2005, 159): “excess of black bile,” *ean hyperballêi* (954a22f.) to refer to the amount of black bile which is assumed at a21 as cold and a24 as hot; a31f. explicitly combines a large amount with these temperatures (less clear Flashar’s [1975] translation of a22: “wenn sie im Körper das richtige Maß überschreitet”). This meaning should then be assumed as well at 955a38f. *to hyperbolên echein*.

31 The non-linear structure (see above p. 359ff. with n. 18) that lists alternative possibilities belies van der Eijk’s view (1990, 60) that there is an “eingeschobener Exkurs” (2005, 159: “digression”) before 954b26; the remark on exceptional men (b25–28) does not follow up on a39–b4 and identify *ex post* that earlier form of difference or distinction (a39–b4) as that of exceptional men, see below p. 365.

is addressed for the first time after the introductory section, however we do not learn more than the sheer fact that such men are exceptional—however, which is this “certain mixture”? In this particular state the person affected is on a slippery slope because, if neglected, this condition leads, depending on the temperature, to very serious forms of mental, emotional or bodily illness (b28ff.)—these results are not the modest forms of gloom everyone experiences at times (b16) but they are such a severe disorder that men commit suicide (b31, cf. 955a4ff.).

The organization of thought of the chapter could be explained from this focus on extreme conditions which are, however, occasionally put into the wider context of the experiences and behaviors of more ordinary people and thus cover in a quite comprehensive manner most of the other possibilities of emotional or mental states caused by black bile. Yet in its meandering course the main direction of the argument pursued is that of excessive conditions. The structure in the whole chapter could be described in the following way:³²

A. Introduction: the melancholic nature of extraordinary men

I. The condition of exceptional men (953a10–32)

B. General principles of the matter and working of black bile

II. Use of analogies to explain the material condition of black bile (953a32–954a11)

C. Specific conditions of black bile

III. First description of the serious effects of a great amount of black bile at extreme temperatures (954a11–26)

IV. Mild impact of food on behaviors (954a26–28)

V. Serious effect of the mixture of black bile that resides in one's nature: it changes behaviors in a rather extreme way (954a28–39)

VI. Reduction of extreme heat to a middle value is cause of better than average qualities; daily experiences of mood swings in most people with moderate conditions of black bile (954a39–b20; b23–25)

VIIa. Extreme effects of a great amount of black bile at extreme temperatures (954b20f.; b25f.)

VIIb. In a certain mixture it produces exceptional men (954b26–28)

VIIc. If neglected, melancholic diseases can result both from very hot and very cold temperatures (954b28–955a36)

32 Indentation to the right indicates the middle or weaker condition of black bile.

VIII. Possibility of a well-tempered and appropriate condition of the unstable black bile that exists in an excessive amount and produces extraordinary men (955a36–40)

An understanding of the rationale behind the structure of the text can help to identify clearer the context of the statements on exceptional men and the condition of this particular type of melancholic persons. In section C, the account is dominated by the description of extreme conditions (III; v; VIIa; VIIc). The state of the middle (VI, 954a39ff.) is only briefly introduced as a variant of, or an alternative to, the extreme conditions: an extreme temperature has been reduced to a middle. However, the middle or mean is not the beacon, it is not the norm after which the other possibilities are judged.³³ The middle is a slump in intensity compared with the previously described extreme conditions, a weaker state than the excess. While it is a state whose outcome (accomplishments in the arts, etc.) one could judge favorably this is not expressly stated—this particular outcome is simply observed.³⁴ However, the concept of a middle, a mean, is not the point of reference for this section VI—the only one where *metrion* and *meson* occur at all³⁵—and the many attitudes discussed here are not grouped around a middle as a kind of cornerstone. The nature of the subject discussed excludes such an option. Drinking of wine that serves as an analogy to the working of black bile starts with the first sip and can end with alcohol poisoning, and *Pr.* 30.1 lists the effects wine has at progressive stages of getting drunk and describes the changes in one's behavior that occur (953a38f.). There is no point marked in this development which would represent the moment when pleasant and stimulating effects³⁶—the “middle”—turn into embarrassing or harmful experiences and can be even deadly (954b36ff.). The concept of a middle is absent in the analogy of wine

33 Contra Klibansky et al. (1964, 33f.): “Then, too, there is the notion of the ‘mean’ (μεσότης) which determines the ideal melancholic in the same way as it determines the ideal mental and physical performance in the genuine Aristotelian writings.” Leaving aside the mean (stressed as well *ibid.* p. 40), “the ideal mental and physical performance” is not accomplished in Aristotle's ethics through black bile.

34 It is remarkable how non-judgmental, non-evaluative this treatise is throughout (except once outside of the topic: masturbation of boys “due to lack of self-control”, 953b37); it limits itself to a description but withholds judgment, in a way Aristotle does not (cf. *EN* 2.5.1106b22: the mean (*meson*) is the best, *ariston*), the only exception being *Pr.* 30.1.955a36f.: the anomaly can be *well mixed* (*eukraton*) in a somehow good state (*eu echein*).

35 *meson* 954b1; *mesos* b24; *metrion* 954b14.

36 Cf. 953b30ff.; *Arist. Pol.* 8.5.1339a17–20.

employed here; its effects are presented rather on a sliding scale of ever increasing negative results.

In the presentation of the effects of black bile the argument develops somehow differently³⁷ because alternative conditions, most of the time the *opposites* of hot and cold, are contrasted. In the first more extensive and specific treatment at 954a11ff. the contrast of the effects of cold and hot respectively is dealt with twice (a21–26; a30–39). The following stage is characterized by a modification of the extreme hot temperature in such a way that it moves to a middle value. This stage is, however, not introduced as producing qualities of the middle between two extremes but it is a—we might say: desirable—less radical variant to the effect of the previously mentioned exceeding heat (see above p. o); all we learn is that this middle temperature produces qualities that don't show the extreme effects of that heat.

954b21ff. deserves a closer look. Here, differences in the shape of a face are introduced in order to illustrate a specific condition of black bile. Shapes that are beautiful, ugly, or without outstanding features (*mêthen echontes peritton*) are mentioned, and here the qualification “these are middle in their nature” (*mesoi tên phusin*) is added—this addition seems to refer only to the last mentioned characteristic “without distinctive” or “without outstanding (*peritton*) features.”³⁸ If this is correct then the “middle” would not be a pretty face (as in a similar analogy Aristotle assumes),³⁹ and conversely the pretty is not the middle between two forms of ugly but the beautiful is in the same way as the ugly a rather extreme deviation of what is middle, of something nondescript—this is clearly not the Aristotelian concept of middle (*meson*).⁴⁰ In the application of this analogy to black bile those “who share in this mixture to a small degree” are characterized as “middle” (954b24f.). “Middle” refers here only to average men who lack what would be in the analogy used beautiful or ugly features of a face. In the context of this explanation “middle” is removed completely from anything distinguished. The possibility that an attitude is both a mean between extremes and top in terms of quality as Aristotle assumes it

37 Another difference is noted by Müri (1953, 23): in the advanced stages of drunkenness after excessive excitement the intoxicated person crashes and ends up in stupor whereas in the description of the effects of black bile this is a separate development, caused by cold temperature.

38 Cf. Flashar (1975, 254) who places “das aber sind die durchschnittlichen Naturen” in brackets.

39 *Pol.* 5.9.1309b23–29.

40 *EN* 2.5.1106b22: the mean (*meson*) is the best (*ariston*); giving in to emotions too much or too little is not “well,” (*eu*); b18–21.

for the *megalopsuchos* at EN 4.7.1123b13 is not seen in *Pr.* 30.1. The sequence of arguments confirms this: It is at this juncture that the text turns to the issue that was raised at the beginning of the chapter: with these just described average persons are *contrasted*⁴¹ those who possess a great amount (of black bile): they are “exceedingly melancholic” and “when mixed in a certain way they are exceptional” (*perittoî*). Clearly the specific mixture of excellent men is not one of the middle as referred to in the preceding sentence, namely as falling short of exceptional qualities whichever way.

3 *Pr.* 30.1 and Aristotle

Whereas for Aristotle the middle, the mean, lies between the extremes of excess (*huperbolê*) or deficiency (*elleipsis*),⁴² *Pr.* 30.1 knows only excess (*huperbolê*),⁴³ which is never paired with the extreme at the other end of the spectrum, deficiency (*elleipsis*). This is obvious in the last sentence of *Pr.* 30.1 (955a38) where only excess is mentioned. The term deficiency (*elleipsis*) itself, or any verb derived from it, is not used in *Pr.* 30.1.⁴⁴ This is a necessary consequence of the basic assumptions the author of *Pr.* 30.1 makes: the *two* ingredients of the mixture, hot and cold, are considered to be separate. The mixture is assumed to add e.g. both boiling water and ice into a pot. The element that is in the more elevated or extreme state prevails, and this condition determines the working of black bile—that the other one is weak and therefore without effect does not need to be stated. On this assumption chilling down is not described as reduction of *heat* (which it is of course) but as a strong and overpowering presence of *cold*, and it is the presence of any of the two elements of the mixture in a strong form that ultimately counts. Returning to the example of mixing hot water with ice: both the amount of each and the temperature decide on the temperature of the final mix, and this could turn out to be any degree imaginable. This variety of possibilities explains the wide range of mental and psychological states described in *Pr.* 30.1 (see below p. 379).

By contrast, in Aristotle *one* quality allows different conditions, one at a time, between the extremes of *either* very deficient *or* overly strong, which are both perceived to be bad alternatives, and this concept explains the arrangement of

⁴¹ 954b25ff. *hoi de plêthous scil. metechontes*.

⁴² EN 2.5.1106a28f. and passim.

⁴³ 955a26; a39, cf. the verb *huperballein* 954a23.

⁴⁴ *Pr.* 30.1 does not assume in an Aristotelian way two extremes of the mean, only excess and a small amount (954b19; b24), not deficiency.

the conditions in the three categories-pattern as the two opposite alternatives of excess (*hyperbolê*) or deficiency (*elleipsis*) and between them the middle. The situation is completely different and more complicated in *Pr.* 30.1 where *each* of the two qualities, hot and cold, could be weak or strong, and its condition is compared in its respective strength with that of the other, and here only the stronger one matters. In this set up a middle or mean is not an alternative that recommends itself as an option as it is the case in the Aristotelian assumption of the extremes of excess (*hyperbolê*) and deficiency (*elleipsis*) which asks for a middle ground. In *Pr.* 30.1 excess is not presented as a deviation from the middle. Having no *exceptional* (*peritton*) features in one's face is the middle, and in the same way men with a *small* share in the mixture of black bile are still "middle" 954b23–26—this is not the Aristotelian middle which represents the best state (see above p. 366f.)—but cannot be mediocrity.

Another concept cannot be used for the explanation of the working of black bile, that of a balance. There is in the temperatures of black bile not one state determined as a balanced mixture of the two—an assumption that underlies many modern explanations of the extraordinary quality of some men. Excessively severe results caused by a large amount of black bile under extreme temperatures are *contrasted* with conditions that lean towards the middle temperature (954a39f.), but here not a balanced state of the two temperatures is reached but the warm mixture is brought to a moderate (*metrion*), temperate state (b14f.); people thus affected can be above average (b2–4) or share the common experiences⁴⁵ of daily mood swings (a39–b25). This description leads to yet another account of effects a very large amount of black bile (b25ff.) can produce: men who possess it are "excessively melancholic."

One cannot find in *Pr.* 30.1 the conceptual framework of a mean that controls Aristotle's ethical and political philosophy. Making the middle the center of the argument of *Pr.* 30.1 (cf. n. 33) misconstrues completely the organization of the thoughts developed here, it ignores the focus of the investigation, the logical relationship of the stages distinguished here, and the concepts actually used. These fundamental differences exclude Aristotle as author of *Pr.* 30.1.⁴⁶

45 "We are often in a condition . . .," 954b16f.; "... happens to *all*; in *all* is something of this potential mixed," b19f.

46 Tellenbach (1983, 8–11) names Aristotle as author of *Pr.* 30.1. Contra van der Eijk (2005, 155): Aristotle is not the author. It is not the subject of this paper to determine whether Theophrastus was the author of this chapter. This was the position of Müri (1953, 21) and Regenbogen (1940, 1402f.), differently van der Eijk (2005, 167 n. 91): Theophrastus is not the author.

van der Eijk 2005, 155, addresses the relationship between Aristotle and *Pr.* 30.1 from the angle of “assessing the Aristotelian character of the theory,” that is “the theory on melancholy and ‘genius’” in *Pr.* 30.1. “What matters is to define the relationship between the theory elaborated in *Pr.* 30.1 and Aristotle’s own views on melancholy more precisely, and to examine any possible reasons for ruling out Aristotle’s views as a *source* for the selection made by the author of the *Problemata*.” In what follows, van der Eijk focuses on the argument that what Aristotle wrote about melancholics can be either found in *Pr.* 30.1 or reconciled with the views expressed there. However, this focus seems too narrow, and what is missing in this strategy is a complementary approach as we just undertook it, that is of examining whether the specifics of the working of black bile and the theoretical framework in which this is presented can be reconciled with Aristotle’s views on the causes of human behavior, and it will be this strategy I will pursue here. This is particularly appropriate since there is enough overlap between issues discussed in various contexts in Aristotle and in *Pr.* 30.1 respectively.

van der Eijk⁴⁷ suggests that the psycho-physical and moral features Aristotle associates with a melancholic person easily fit into the theory of *Pr.* 30.1 (160). He assumes that the author of *Pr.* 30.1 is well informed about Aristotle’s concept on melancholy and “seems to make an effort” to “take it into account wherever possible” (160f.). He disagrees with scholars who argued that the views expressed in *Pr.* 30.1 could not be reconciled with those in Aristotle’s authentic work. van der Eijk rejects the argument that Aristotle associates only negative qualities with being melancholic⁴⁸ which “would be irreconcilable with the characterization of melancholics as ‘extraordinary’ (*perittoi*)” (161). van der Eijk points out that *Pr.* 30.1 shares with Aristotle the negative assessment of the effects of being melancholic whereas there the condition of being extraordinary (*perittos*) is the “*exception* rather than the rule” (161). This condition “was apparently a *negligible* factor and as such played no part in Aristotle’s theory of virtue . . .” (162). This is to say: Aristotle focused on “ordinary men,” not the “extraordinary.” The consideration of exceptional men is considered as pretty irrelevant in *Pr.* 30.1 itself and used there only “as a starting point for a discussion on the instability (*anômalia*) of the melancholic nature rather than for any other purpose” (162). van der Eijk makes his case by offering an assessment of the focus of *Pr.* 30.1, and in this assessment the condition of extraordinary men was not central to its argument. If there is in this respect a difference

47 Section 6 of van der Eijk (2005), 160–67, is entitled “The Aristotelian character of the theory in the *Problemata*.”

48 This point has then been made again by Centrone (2011, 334).

between Aristotle and the author of *Pr.* 30.1 it does not permit the conclusion that his concept and the views expressed in *Pr.* 30.1 are irreconcilable.

While I agree that the explanation of the exceptional quality of very few men, the *perittoí*, appears disproportionately brief in this study of *Pr.* 30.1 compared with the account of various effects of black bile, one needs to acknowledge that all the other effects of black bile receive only the shortest treatment in quick succession, while to none of the many effects of black bile is as much attention given as to that of producing extraordinary men at the beginning (953a10–32). Furthermore, in our analysis of *Pr.* 30.1 the focus is there on the extremes or at least the qualities that prevail, they are not “negligible” or nothing more than the “starting point for a discussion.”

Turning “to the question about where to place the melancholic *peritton* in Aristotle’s theory of virtue” van der Eijk admits that we lack in Aristotle “explicit statements on the subject” (164). However, Aristotle does not omit in his “theory of virtue” extraordinary qualities. One instance is magnificence (*megalorepeia*, *EN* 4.4.1122a18ff.) which differs from simple liberality (*eleutheriotês*, 4.1.1119b22ff.) and another even more noteworthy example is his *megalopsuchos* (*EN* 4.7, cf. 1122a34ff.) whose quality is the “crown of the virtues” (1124a1). Aristotle includes among the subjects of his investigation types of character which are rarely found, however, none of the extraordinary types of men he deals with owes his exceptional quality to the specific condition of black bile.

Moreover *Pr.* 30.1 does not discuss melancholic *perittoí*—or any other condition caused by black bile—with regard to virtue, it refers rather to excellence in the areas of politics, philosophy, poetry, and the arts (953a20–30; 954b3) and deals more with exceptional accomplishments than ethical qualities like virtue—the term *aretê* is never used; and since in *Pr.* 30.1 among the exceptional men those active in politics are listed, one could refer for a counterpart in Aristotle to a man of rare superiority like “a god among men” (*Pol.* 3.13. 1284a3ff.). He might be a theoretical construct, but Aristotle does not explain that he would become a reality if only he were a melancholic of a certain type. A reality was Pericles who is mentioned at *EN* 6.5.1140b7–11 for his excellence in *phronêsis* which, however, is not presented as the result of his black bile. Aristotle obviously would not have subscribed to the idea that all extraordinary men were melancholics.

In order to establish a link with between Aristotle and *Pr.* 30.1, van der Eijk (2005, 164) refers to the principle “of the *êthopoion* of the *phusis*” which is correct for *Pr.* 30.1,⁴⁹ but not for Aristotle’s *Nicomachean Ethics* where nature is no more than the basis on which habituation is built. Nature is not a sufficient

49 955a32–34, cf. *êthos* 953a35; b22; 954a27; a29; b21.

condition to form qualities of character that go beyond those of animals or children (6.13.1144b4ff.); only through habituation do men receive perfection in their character (*êthos*, 2.1.1103a18–26). In *Pr.* 30.1 the instability of *êthos* is a result of the change of temperatures of black bile (954b9f. “at one time cold, at another hot”), and this concept is not that of Aristotle for whom *êthos* is generally a stable *hexis*.⁵⁰

There is one context in Aristotle in which *êthos* can be the mood or behavior of a short period of time, and here I find similarities with *Pr.* 30.1. It seems not to have been recognized that the expression found at *Pr.* 30.1 “to become of every quality in one’s character” (*ta êthê gignontai pantodapoi*, 954a29), and “men are of a certain quality in their character” (*poioi tines eisi ta êthê*, 954b21) has its exact equivalent in Aristotle, *Pol.* 8.5.1340a7: “we become men of a certain quality in our character” (*poioi tines ta êthê gignometha*). The way this change in one’s *êthos* takes place is described in both texts with the same words, regardless of whether the change is caused from outside, by music, as in Aristotle, or from within, by black bile, as in *Pr.* 30.1; and in both texts these changes can be quite extreme, leading to enthusiastic behavior (*Pol.* 8.7.1342a7; *Pr.* 30.1.954a36). Furthermore, both texts share the larger picture of an assessment of all men with regard to the qualities envisioned: all men possess them, some to a smaller degree, others stronger (*Pol.* 8.7.1342a4–6; a13; *Pr.* 30.1.954b18–21). However, in Aristotle these remarks are only the first step towards proving the human potential for acquiring a certain lasting quality through habituation, that is here by exposure to music of a certain kind (*Pol.* 8.5.1340a14ff.). His concept of habituation is based on the fact that changes of one’s *êthos* can be accomplished, in *Politics* at a very young age through music, and such an additional and necessary personal effort to develop a permanent attitude beyond the temporary change of one’s *êthos* is missing in *Pr.* 30.1. *Êthopoios* in *Pr.* 30.1 does not contain the notion of creating a permanent character trait as in Aristotle, it is a result of one’s nature, that is, one’s natural condition of black bile.

van der Eijk (2005, 164f.) tries to salvage the Aristotelian character of the role of “nature” in *Pr.* 30.1 by referring to the “special predisposition,” *euphuia*, which exists in Aristotle’s *Poetics* as a quality that has not been formed by habituation or teaching, e.g. as the natural ability to produce good metaphors (22.1459a5–7).⁵¹ While such a disposition is mentioned in *Pr.* 30.1 as a result of

50 Cf. Schütrumpf (1970, 2–22).

51 This is based on the ability to recognize similarities. Centrone (2011, 339) considers correctly the reference to this ability as insufficient to establish a link between a melancholic condition and the requirements for philosophy in Aristotle.

a great amount of black bile at high temperature (954a31f.), no “connection that enables the melancholic *peritton* in the areas of philosophy, politics and poetry” with *euphuia* is established there.⁵² The condition of black bile creates among other qualities *euphuia*—this condition is mentioned together with being manic (*manikos*) and lusting for sex (*erôtikos*)—however, this is not the underlying quality for the accomplishments in the arts. When Aristotle mentions in another passage in *Poetics* (17.1455a32f.) that poetry is produced by a gifted man (*euphuos*), and he adds as alternative “or⁵³ one in a manic state” (*manikou*), he obviously means with gifted not someone who writes in an agitated state, and this is the exact opposite of the statement in *Pr.* 30.1.

Furthermore being *euphuês* is for Aristotle in no way a result of a condition of black bile whereas in *Pr.* 30.1 black bile is the one and only cause of accomplishments and behaviors. van der Eijk (2005, 166), downplays this fact when he calls it “the physiological aspect to people’s mental processes and ethical behaviours,” considered “frequently in the *Problemata*” (166). Physiology is not “frequently” considered, it is the only force used to explain the variety of behaviors and attitudes.

Returning to the question of whether the author of *Pr.* 30.1 followed Aristotelian *ethical* concepts: There is very little common ground since Aristotle in the *Nicomachean Ethics* is uniquely interested in the formation of stable qualities through habituation whereas *Pr.* 30.1 deals either with temporary moods or with more permanent conditions, and in both cases exclusively through the working of black bile. In Aristotle black bile is not mentioned as an additional factor that complements his explanation of qualities one acquires through habituation or learning, and vice versa *Pr.* 30.1 does not recognize that the conditions and behaviors he deals with have origins other than the specific nature of the individual mixture of black bile as Aristotle insisted on. In *Pr.* 30.1 the recurring theme is the mutability of black bile which, as we learn, is not in a stable condition, and, correspondingly, men’s behavior is not assumed as static but subjected to changes. This proneness to change, to mood swings, the impermanence of emotional states, the risk of deterioration unless one “pays attention” (954b28) that are assumed here contrast with the concept of the Aristotelian ethical theory which focuses on developing a stable *hexis* which

52 Contra van der Eijk (2005, 165), from where the quote is taken.

53 Tarán & Gutas (2012, 193) print *μᾶλλον ἢ μανικοῦ* (“rather than in a manic state”) which the Greek source of the Syriac translation “clearly had” (Gutas 400f.), a reading Tarán (274f.) defends. (I owe these references to R. Mayhew). However, would Aristotle have bothered to explain *manikos* by *ekstatikos* if this option was all but dismissed by him?

is praiseworthy (1.13.1103a9), a firm attitude towards emotions (2.5.1106b16ff.) which is the prerequisite for actions to be considered as just or moderate.⁵⁴

According to *Pr.* 30.1, our emotions are not formed through habituation under education but are a product of a specific, at times momentary physical condition that is controlled by the amount and temperature of black bile. “This condition causes a remarkable difference in the face of dangers so that many men at certain times act in inconsistent ways under fear⁵⁵ . . . they differ from who they are. Just as the mixture of black bile is responsible for changing men when they are sick so it is in itself vacillating; for at times, like water, it is cold, at other times warm” (954b4–10).

While one cannot establish a connection between the enterprise of Aristotle’s teaching on the shaping of character through habituation in *Nicomachean Ethics* and *Pr.* 30.1 one might consider whether Aristotle’s concept of emotions developed in *Rhet.* 2 does not show more common features with *Pr.* 30.1. In Aristotle’s *Rhetoric* some emotions, as those referred to in *Pr.* 30.1, are described as a response or reaction towards perceptions⁵⁶ of things that are pleasant or threatening, based on an imagination (*phantasia*) of future developments that affect in one way or another one’s well-being, social standing, etc.⁵⁷ The explanation of fear in Aristotle’s *Rhet.* 2.5 which uses these concepts has no counterpart in *Pr.* 30.1. There no *perception* of something that could affect a person’s well-being triggers off emotions—no cognitive element in the arousal of emotions is recognized here. Just the opposite, this individual might *not understand* the cause for his mood (954b16–20), there is no frightening experience of which he has formed an impression. In other cases when terrifying news hit a person they affect directly the specific mixture of black bile and turn the person affected into a coward (954b10–14) without being processed by the mind first. This treatise knows of “the location where reasoning is located” (954a34f.), and the way it is affected by the temperature of black bile accounts for manic or enthusiastic conditions (see above p. 360). Aristotle’s concept of perception as a capacity of the soul (*EN* 6.2.1139a18) is ignored—or abandoned—in favor of an exclusively physiological explanation.

54 E.g. *EN* 2.3.1105a30: actions qualify as just or moderate if the person who acts does so from a certain quality among which Aristotle mentions: “if he acts in a stable and unchanging condition” (*bebaiōs kai ametakinētōs echōn*).

55 At 954b6, instead of μὲν τοῖς φόβοις read [μ]ὲν τοῖς φόβοις—there is no δὲ to answer μὲν. For ἐν φόβοις cf. *EN* 3.11.1117a18; *MM* 1.20.1190b14, see Flashar (1975, 721 n. on b6).

56 See Fortenbaugh (2002, 17f.).

57 Cf. 2.5.1382a21ff. on fear; 1383a17 on self-assertion; 6.1384a22 on shame; 8.1385b13 on pity.

The description in *Pr.* 30.1 of the response to frightening experiences as being determined entirely by the condition of black bile contains a dimension which is absent in Aristotle's explanation of the development of emotional states: There is no room for ethics in the approach of *Pr.* 30.1. While the author of *Pr.* 30.1 pays attention to the different ways of dealing with dangers (*eis tous kindunous*, 954b4) he mentions only the effect that men become cowards. There are conditions which make them insensitive to fear and produce a middle attitude; however, this is not called courage—the term *andreia* is never used. Aristotle on the other hand describes one form of courage, that of citizens, as the firmness to withstand dangers (*EN* 3.11.1116a17–19). The author of *Pr.* 30.1 might well be aware that one cannot call the calmness in the face of dangers caused by black bile “courage,” and this he shares with Aristotle who in the *Nicomachean Ethics* never associates black bile with a virtue but mentions it only in the context of lack of self-control (7.8.1150b25, 11.1152a19, a27f., 15.1154b11).

On the topic under consideration Aristotle and the author of *Pr.* 30.1 are worlds apart. When Aristotle lists at *EN* 3.11 (1116a16ff.) five forms of courage he does not include the case that in fearful situations a rather hot black bile is cooled off to a middle amount—a state which would result in courageous behavior—as the author of *Pr.* 30.1 does (954b14f.). The “middle” of *Pr.* 30.1 is not the result of having assumed a certain attitude through habituation as in Aristotle (*EN* 2.1.1103a17ff.) but is the result of the interaction between a given temperature of black bile and temperature-changing experiences a person is going through. Here we find *êthos* (954b21, see above p. 358 with n. 6; 370f. with n. 49), however, without reference to *aretê* or *kakia* while these two are in Aristotle the quality of the *êthos*.⁵⁸

Aristotle's view that ethical virtues are firm attitudes towards emotions (2.4.1105b25–28) is based on a psychology in which an irrational “part of the soul” is subdivided. One of these parts listens to reason (1.13.1102b13ff.). This “part” of the soul can be formed by habituation (2.3.1105a28ff.).⁵⁹ “Soul” is never mentioned in *Pr.* 30.1. This physiological explanation is of a very different form than that found in Aristotle, who defined enthusiasm as “an emotion of the *êthos* of the soul” (*Pol.* 7.5.1340a1f.). If one wants to find any influence of Aristotle at all then it would be the adoption of the terms that indicate a specific condition (*hexis*, *diathesis*), but while they refer in Aristotle to the soul and determine the actions a man of this kind performs,⁶⁰ they are used in

58 *EN* 3.1.1111b6; 4.13.1127a16; 10.8.1178a16f. *et passim*; *Poet.* 2.1448a2f.; *Pol.* 5.11.1315b9; *Rhet.* 1.2.1356a23; 2.13.1390a17; 3.12.1414a22.

59 Cf. 6.2.1139a1ff.: ethical *aretai* are the virtues of the *alagon*.

60 *hexis*: *EN* 1.8.1098b33; 13.1103a9. *diathesis*: *EN* 2.8.1108b11–16; b30.

Pr. 30.1 for the condition of the black bile⁶¹—again in the context of the effects it has on human behaviors.

Correct was Theunissen (1996, 5) who described the position of the author of *Pr.* 30.1 as “Physikalismus.”⁶² Physicalism removes human responsibility, so much so that according to the author of *Pr.* 30.1 one does not know what is going on with one’s humors (954b15–18), let alone that one can control black bile or is responsible for it—except that one could avoid certain food (954a26f.) or seek medical treatment (954b28). Men are the target, are objects or victims of forces that are endowed with power, and the language reflects this condition: “depressions take hold of them” (955a6); “old age takes away heat” (a10). This is a form of depersonalization. The option of *EN* 7.11.1152a27 according to which the form of lack of self-control which men with a melancholic condition possess is easier to *heal* than another form in which men make a decision but are too weak to carry it through is missing in *Pr.* 30.1. The treatment envisioned there is not ethical but focuses on black bile itself (954b2ff.), it is medical.

Can the views of Aristotle and *Pr.* 30.1 be reconciled? Not in my opinion since both Aristotle and *Pr.* 30.1 offer an explanation of their position that is complete in itself and excludes the explanation the other proposes: neither does Aristotle indicate, or allow, that black bile could be more than a very limited factor that affects man’s behavior,⁶³ nor does *Pr.* 30.1 indicate that acquired attitudes play any role and could act as a counterbalance against the physiological impact of black bile.

Aristotle himself distinguishes in *De anima* 1.1.403a29ff. the approach a dialectician and a scientist working in physics choose and illustrates the difference with the respective understanding of anger: for the former it is the desire to retaliate by inflicting pain, for the latter the boiling of the blood around the heart and of heat. The physicist provides the matter, the dialectician the form and principle. According to the distinction made in *De anima* 1.1, the approach in *Pr.* 30.1 is that of a physicist, that in Aristotle’s *Nicomachean Ethics* and *Rhetoric* of the dialectician.

This Aristotelian distinction can be used in order to answer the other question: was Aristotle the source for the author of *Pr.* 30.1? While it is possible that he knew Aristotle’s few comments about melancholics I see no way that the specific assumptions about the working of black bile found in *Pr.* 30.1 are developed out of, or were inspired by, the few remarks about melancholics we

61 954b5; b 27 (*hexis*), 955a38 (*diathesis*).

62 It is, however, lopsided to consider this position as “antiplatonisch”; in its rejection of the possibility of training and education, it is as well anti-Aristotelian and anti-Sophistic.

63 See above p. 374 about lack of self-control.

find in Aristotle. Much closer to the description of the effects of the different conditions of black bile found in *Pr.* 30.1 comes at *PA* 2.4.650b27 where very much the same changes in behavior are described as in *Pr.* 30.1, with the focus on fear and cowardice; however, in *PA* 2.4 they are the result of the thickness or watered down quality of blood, not of black bile!

However, there are in the larger scheme of things commonalities that unite Aristotle and *Pr.* 30.1 and separate them from a way of thinking that still can be found in the fourth century B.C. We see Aristotle sharing with the author of *Pr.* 30.1 the approach of moving away from any sort of religious explanation by focusing on nature.⁶⁴ Were other intellectuals of the fourth century aware that such a move should be made, did anyone articulate it? I think so: we find a similar approach in Dicaearchus 56A sect. 3 (Fortenbaugh-Schütrumpf).⁶⁵

Dicaearchus, a student of Aristotle and a generation younger than his teacher, describes in his *Life of Greece* the life under Cronus, that is the golden age, adding respectfully some doubt about whether it actually ever existed and was not called so without foundation, and therefore in his description he proceeds by “leaving out what was too much of the sort of a myth” and promises to “trace it back to *natural* condition based on reason.” We find here Dicaearchus using aspects of mythology, but stripping them of their mythological features by identifying through rational criticism the cause of the quality of this so-called life under Cronus.⁶⁶ The same happens in *Pr.* 30.1: There is still the suffering of heroes (953a14ff.), the frenzy and ecstasy of the poets, but it is not sent by the gods but is reinterpreted as part of the physical make up of an individual. What was called in the past “a sacred disease” is now explained as the result of one’s “nature” (953a14–16). By this change not the Muses or gods, but poets, get credit for what they did, at least generally.⁶⁷ Under this new way of seeing things, poets did no longer have to start their works with prayers to the Muses asking for inspiration because the Muses are not the source of their poetic productivity, a poetic talent is not a divine inspiration as still Plato (*Leges* 3.682a; 7.811c8ff., cf. *Ion* 534b3ff.) had maintained, and a poet is more than a medium.

64 Cf. van der Eijk (2005, 56f.).

65 Dicaearchus 56A sect.3 (from Porphyry) τὸ δὲ λίαν μυθικὸν ἀφέντας εἰς τὸ διὰ τοῦ λόγου φυσικὸν ἀνάγειν, cf. Schütrumpf (2001, 261 with n. 25; 275).

66 Dicaearchus explained the bliss of the golden age by one trait of these people, namely that they did not kill: they did not kill animals and as vegetarians they enjoyed the long life mentioned in the myth, and they did not kill other men and that accounted for the eternal peace of that age.

67 One might dispute whether such praise is deserved in the case of those poets who as a result of their medical condition were out of their normal self.

Nature and frenzy without influence of the divine as we find it in *Pr.* 30.1 was already an Aristotelian concept as the *Poetics* shows (17.1455a30–34),⁶⁸ and it seems more than a coincidence that there is in Aristotle an example of the scientific analysis of *nature* in terms of temperature: at *Rhet.* 2.12 we read: “Young men like people who are drunk from wine have elevated temperature from their *nature*” (1389a18)—it is nature that causes the temperature of young men to rise, as that of old men is low, which explains their cowardly behavior and negativity (*Rhet.* 2.13.1389b29, cf. *Pr.* 30.1.954b12.). It is not only the *Rhetoric* which refers to temperature as an explanation of the condition of age groups, we find the same in *Pol.* 7.17.1336a20 where the recommendation to get children used from early on to enduring cold temperatures is justified by the fact that their body-temperature is warm⁶⁹—however, not because of a condition of black bile!

Specific topics remained of interest over time like the source of poetic inspiration or the assumption of different body-temperatures in different age groups, and certain observations remained the same; however, their explanations changed, if there were any given at all.

At the beginning of this paper the role of analogies for the explanation of the working of black bile and the important part of the effects of wine in these analogies was emphasized.⁷⁰ The author of *Pr.* 30.1 was not the first to observe them. Before him quite a lot of attention to the effects of drinking wine was given by Plato in *Leges*: he describes the various emotional effects drinking has: it intensifies emotions like pleasures, pain, anger, and erotic desires but weakens perceptions, opinions, reasoning (1.645d–e). He outlines several stages of feelings as they develop and succeed one another during drinking: from being good-humored over becoming hopeful to boldness in words and deeds.⁷¹ He mentions (2.672d4) a widely shared view which claims that wine is given as a punishment to men so that they fall into madness, and Plato himself

68 The last sentence in Butcher's translation is: “Hence poetry implies either a happy gift of nature (*euphuos*) or a strain of madness (*manikou*). In the one case a man can take the mold of any character; in the other, he is lifted out of his proper self” —“lifted out of his proper self” misses the severe emotional state of being ecstatic (*ekstatikoi*). See above n. 53.

69 In the *Politics*, Aristotle does not refer to the different temperatures of male and female to explain the gender of the newborn as in *De generatione animalium*, cf. Schütrumpf (2005, 519 n. 41, 27) on 7.16.1335a13.

70 See W.W. Fortenbaugh's paper, in this collection: ch. 6, “On *Problemata* 3: Wine-Drinking and Drunkenness.”

71 *Leges* 1.649a7 for hopes; cf. *Pr.* 30.1.953b3. At *Leges* 2.671b3–5; c5 Plato adds shamelessness as another result of drunkenness.

expresses later the opinion that wine makes unstable and mad (6.775c7). These are just observations without any claim of explaining why the body reacts in the way *Pr.* 30.1 described very much the same symptoms. Only once Plato rises above description when he states that to give wine to the young means to channel fire to fire, given their manic disposition (*emmanês hexis*, 2.666a). Here he reveals a view about the temperature of young people, as we found it in Aristotle *Rhet.* 2.12 and in *Pr.* 30.1. When Plato in the same context at *Leges* 2.666a–b contrasts the frenzy of youth with the depression in old age, similar to *Pr.* 30.1.955a3–5, one might here as well assume that Plato finds in old people a decreased temperature although he does not say this in this context; however, at *Leges* 6.761c he orders the young to establish gymnasia for themselves and “warm senior baths for senior citizens”—their generally low temperature recommends warm baths.

Plato knows of the hot temperature of the young as does Aristotle in *Rhet.* 2.12. While it is not spelled out in Plato, *Leges* 2 and Aristotle, *Rhet.* 2.12 which part of the body is actually hot or what causes the heat,⁷² the author of *Pr.* 30.1 is very specific by identifying this as black bile and giving its location in the body, and this is clearly a new scientific dimension over and above the account of Plato and Aristotle.

Rhet. 2.12 and *Pr.* 30.1 share the approach of providing observations about specific forms of behavior, specifically about deviations from the norm caused by bodily conditions which are nature’s way of acting. However, at *Rhet.* 2.13, in the chapter about old men whose behavior is traced back to their cold temperature, we learn that negative experiences in their lives, the beatings they suffered and the disappointments they experienced, are additional influences that explain the specific *êthos* of old men whereas at *Pr.* 30.1 such considerations are completely missing. This means, hot and cold are for Aristotle in *Rhet.* 2.13 less exclusively the influences that make men act or behave in a certain way. They are rather in a basic sense natural as the temperature decides whether an embryo in its early stage when it is still undifferentiated in its sex will turn out male or female.⁷³ We are here in the field of genetics referring to the fundamental distinction of gender. However, for the formation of human qualities other factors than those that are responsible for nutrition and growth are responsible.⁷⁴ The part of the soul that listens to reason has to be formed in order to produce the character a man should have, and Aristotle believes that

72 In the same way, at *Pol.* 7.17.1336a20 heat is assigned to children without mentioning black bile.

73 See above n. 69.

74 See *EN* 1.13.1102a33ff.

human nature allows for this additional method of influencing one's personality whereas the author of *Pr.* 30.1 in his mono-causal approach only knows the working of black bile.

The limitation of the single cause explanation of man's behavior in *Pr.* 30.1 is made up for by the description of a great variety of human moods, behaviors and activities not only by themselves but in their relationship to one another. I do not know a single continuous text in Plato or Aristotle that deals with temporary moods to the extent *Pr.* 30.1 does. Klibansky et al. (1964, 33) wrote that *Pr.* 30.1 "has seldom been equaled and still more rarely surpassed in psychological subtlety."

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Homo numerans, venerans, or imitans? Human and Animal Cognition in *Problemata* 30.6

Jason G. Rheins

περιφραδῆς ἀνὴρ· κρατεῖ
δὲ μηχαναῖς ἀγραύλου
θηρὸς ὀρεσσιβάτα, λασιαύχενά θ'
ἵππον ὀχμάζεται ἀμφὶ λόφον ζυγῶ
οὐρειὸν τ' ἀκμήτα ταῦρον.

SOPHOCLES, *Antigone* 348–52

1 Preliminary Points

1.1 *Problemata* 30.6

It is a hard thing for a person to be under the shadow of melancholy; being a πρόβλημα overshadowed by *On Melancholy* (= *Pr.* 30.1) is not much fun either. Odd, short, and far less pellucid than its sister problems on human and animal psychology (30.3 and 12), and less obviously philosophically enticing than many of its fellow problems from Book 30, *Pr.* 30.6 has languished in even greater obscurity, both relative and absolute, than its siblings. But this is not a just fate. This fascinating passage condenses a wealth of intellectual-historical background and a host of challenging interpretive problems into only a few short lines. Above all though, it provides us with a window—a small and rather opaque window, admittedly—into the state of the question of animal (ir)rationality in the Lyceum in the late 4th or early 3rd centuries.

The main question or problem of 30.6 is why man ought to be obeyed (πειστέον) more than other animals, and three possible answers are advanced:

Διὰ τί ἀνθρώπῳ πειστέον μάλλον ἢ ἄλλῳ ζῳῳ; πότερον, ὥσπερ Πλάτων Νεοκλεῖ ἀπεκρίνατο, ὅτι ἀριθμεῖν μόνον ἐπίσταται τῶν ἄλλων ζῳῳ; ἢ ὅτι θεοὺς νομίζει μόνον; ἢ ὅτι μιμητικώτατον, μαθηθῆναι γὰρ δύναται διὰ τοῦτο

Why is it that man is to be obeyed rather than¹ another animal? Is it, as Plato answered Neocles, that he alone of the animals knows how to count? Or that only he believes in the gods? Or that he is the most imitative (for this is why he is able to learn)?

We have four questions in this passage, with short glosses on the second and fourth questions. The first question—“why is it that man is to be obeyed rather than another animal?”—is the actual πρόβλημα, and I will refer to it as “our problem,” “problem 30.6,” or simply “the problem.” It is an explanandum taken for fact but in want of an explanation or cause.

The three subsequent questions are possible explanatia for the problematic phenomenon, phrased in the “is it that . . . ?” form, which is a very typical way of introducing putative answers throughout the *Problemata*.² The three subsequent questions will be referred to as Option A, B, and C, respectively.³ Options A and C both have glosses: ὥσπερ Πλάτων Νεοκλεῖ ἀπεκρίνατο and μανθάνειν γὰρ δύναται διὰ τοῦτο, respectively. The most natural reading of the passage (endorsed herein) is that Option C is the preferred answer of the author. However, this reading is not strictly necessary; e.g. the case for reading Option C as the author’s choice or preference would be stronger if it had particles such as ἄρα or ἔρα οὖν. Nonetheless, there are two important reasons for taking C to be the option preferred: first, only it receives a gloss that elaborates on it or explains its suitability as an explanation. Option A has a gloss, “as Plato answered Neocles,” but this is anecdotal rather than evidential. Second, it is the most Peripatetic of the answers, alluding directly to a passage from Aristotle’s *Poetics*.

1.2 *Problems with Our Problem*

As many previous commentators have noticed, problem 30.6 is a rather odd question.⁴ Compare it to the similar but more intuitively formulated 30.3: Διὰ τί τῶν ζώων ὁ ἄνθρωπος φρονιμώτατος; (“Why is man the most intelligent of the animals?”) That question is straightforward. The second thing to notice is that it is unusual for a πρόβλημα to be this short when it introduces rival explanations. Even when there are only two competing, putative explanantia, it is

1 μᾶλλον ἢ can mean “more than” or “rather than.” On my preference for the latter, see n. 13.

2 When multiple competing explanations are offered following “πότερον . . . ἔτι,” either “ἢ ὅτι” or “ἢ διότι” are the typical ways of introducing the succeeding putative answers.

3 The ideas in Options A, B, and C will be referred to as the *Homo numerans*, *Homo venerans*, and *Homo imitans* view, respectively.

4 Barthélemy-Saint Hilaire (1891, 2:22).

typical for both to receive at the very least a few words of explication or justification; it is even less common for there to be no elaboration when there are more than two possible explanations.

Furthermore, the options are themselves surprising. They are eclectic or ecumenical. The first two, as we will see, represent Pythagorean-Platonic and Socratic-Platonic perspectives on human (cognitive) uniqueness, while only the third is distinctively Peripatetic. They are unusual in other ways. Consider the provisional explanantia of 30.3: Πότερον ὅτι μικροκεφαλώτατον κατὰ λόγον τοῦ σώματος; ἢ ὅτι ἀνωμάλως ἐλάχιστον; (“Is it because he has the smallest head in proportion to the body, or because [it] is irregularly the least?”)⁵ While it would be rather pat to say that the reason that man is φρονιμώτατος is φρόνησις, we still might have expected an answer in terms of the possession of certain cognitive capacities—an answer that was more διαλεκτικός and less φυσικός, as it were.⁶ But these answers are not really surprising given that the preponderance of the tentative explanations in the *Problemata* are material and/or formal in a physiological sense, rather than teleological and/or formal in a psychological sense.⁷ Thus problem 30.6 is unusual in considering three non-physiological, non-material αἴτια, which are also not obviously teleological.⁸ Two related questions about problem 30.6 that we will have to confront are:

- i. What can be discerned from the unusual choice of answers?
- ii. What is the significance and intent behind the problem’s curious formulation?

To these we can add the difficult question of possible authorship and date of composition that is unavoidable for the motley *Problemata*:

- iii. (Can we determine) when or by whom this problem was written?

5 It is uncertain from the text whether the subject that is “irregularly least” is the head or the human body. And to preserve its opacity, I have rendered ἐλάχιστον as the ambiguous “least,” rather than “smallest.”

6 *DA* 403a29–b2. For various reasons given by Aristotle for man being “φρονιμώτατος,” see §§3.2, 5.1–2 below.

7 Mayhew (2011, 1: xxii–xxiii), however, notes that teleological explanations are sometimes found for biological problems, e.g. 4.15 or 10.19.

8 Admittedly, Book 30 as a whole is unusual in this respect. Only a few of its questions receive material, physiological explanations: 30.1 on melancholy, 30.14 on dreams, and the aforementioned 30.3.

We will return to these general interpretive questions in the final section of this essay.

1.3 *Existing Commentary on 30.6*

The points or questions raised regarding 30.6 by the few *Problemata* commentaries can be divided roughly into two kinds: textual issues and source issues, with the second textual issue and the first source issue being thoroughly intertwined. The textual issues are: (1) Whether to supplement line 956a11, to specify a subject for *πειστέον*.⁹ (2) Whether *Νεοκλεῖ* might be a misremembered or corrupted reference to *Κλεινίᾳ*, the Cretan interlocutor in Plato's *Laws* and the Ps.-Platonic *Epinomis*.¹⁰

Regarding the issue of the sources, the following passages are often cited as possible sources or extant developments of the three options:

- A. For the first view (*Homo numerans*), it is usually indicated that we have no idea who the Neocles mentioned in 956a12 is.¹¹ It was, however, a fairly common Athenian name—the name of Epicurus' father, in fact.¹² However, *Epinomis* 976e ff. is always recommended for consideration, either as a potential source or at least an exemplar of this view. Hence the suggestion above that *Κλεινίᾳ* may have been intended. Sometimes in this connection *Top.* 6.5.142b25–27 is also mentioned, where Aristotle references, with little admiration, a definition of man as “what understands how to count” (*τὸ ἐπιστάμενον ἀριθμεῖν*).
- B. The second view (*Homo venerans*) is the one that is least often associated with any specific source(s), although Flashar (1962, 723) references a related claim at *Cael.* 1.3.270b5–9.
- C. For the third view (*Homo imitans*), *Poetics* 1.4.1448b4–9 is given as the *locus classicus* for this Peripateticism.

9 Richards (1915, 150).

10 Barthélemy-Saint Hilaire (1891, 2:22), Flashar (1962, 723), Louis (1994, 3:38 n. 59).

11 Barthélemy-Saint Hilaire (1891, 2:22), Flashar (1962, 723), and Louis (1994, 3:38 n. 59).

12 Flashar (1962, 723). Epicurus' father, Neocles, of the deme Gargettos, was part of the third wave of the Athenian cleruchy sent to Samos in 352/1 (D.L. 10.1, Strabo 14.1.18), so it is *not impossible* that the Neocles mentioned in *Pr.* 30.6 was in fact the father of Epicurus. However, it is *improbable*. Neocles was a fairly common Athenian name (e.g. Themistocles' father *Ath.Po.* 23.3.3; Paus. 8.52.2, Hdt. 7.143). Secondly, this is a case where an argument *e silentio* is unusually strong. The critics of Epicurus took great pleasure in putting the lie to Epicurus' exaggerated claims of philosophical autodidacticism and complete originality. If Neocles had been a figure familiar to Plato's academy, and not just a γραμματοδιδάσκαλος, Epicurus' numerous defamers would likely have seized upon it.

This essay addresses these points in turn before returning in §6 to the general interpretive questions enumerated above (i–iii). §2 provides an answer to the first textual issue and introduces the second. §3 addresses the source issues for Option A and then offers an answer to the second textual issue. §4 identifies and explicates several exemplars and possible sources of the *Homo venerans* view. §5 considers both *Poet.* 1.4.1448b4–9 and a number of passages from Aristotle's biological and psychological writings that are relevant sources for Peripatetic views about imitation and learning in animals and humans.

2 Text of the Question

2.1 *Subject in 956a11*

There are no significant manuscript differences for the problem that sets off this discussion: Διὰ τί ἀνθρώπῳ πειστέον μᾶλλον ἢ ἄλλῳ ζῴῳ; However, it has been suggested that a subject ought to be supplied to it, as *who* ought to obey humans rather than animals is otherwise ambiguous. Richards argued that since the idea of humans obeying animals at all (much less over and above other humans) was too absurd, the question must have meant animals (1915, 150). He therefore proposed adding τὰ ζῷα after πειστέον. It is true that hardly any Greek would take the idea of obeying animals very seriously.

That supplement to the text could be rather interesting, if it meant that the question was focusing on why animals ought to obey humans rather than other members of their own species. One might have presumed that a puppy would sooner learn from or show obedience to, say, its mother or another adult dog, but one might then observe that all the dogs eventually fall into line with their human master. But the possible answers do not seem to address this particular puzzle in any significant respect. They can explain to us why humans have more to teach or command animals (as well as other humans) and why the animal *ought* to listen to a human sooner than another animal. One might well find the idea asking why an animal *ought* to obey A rather than B, as if it had a choice in the matter, to itself be absurd.

Thus Mayhew notes (2011, 2:300 n. 47), in contradistinction to Richards' argument, that "The subject is not stated, and one naturally takes it to refer to humans: Why should one obey humans more than any other kind of animal?" Yet Richards' initial point about the absurdity of asking why humans do not listen to other animals is also a good one; if that possibility were being seriously entertained then at least one of the possible answers would have to be that man alone can speak or can make the most articulate sounds (and thus give instruction!). So, it does not make very good sense to assume that the subject

is either strictly animals or humans. Mayhew ultimately chooses to translate the question as “Why should the human be obeyed more than another animal?” and I think that this corresponds to the best approach: to understand this as an impersonal use of the verbal adjective and to refrain from adding anything unnecessarily to the manuscript texts. Whoever the subject might be, he, she, or it ought to obey humans rather than (or more than) any other species of animals.¹³

2.2 *Emending Νεοκλέϊ?*

Once one recognizes that in the *Epinomis* there is considerable development of the *Homo numerans* view, a rather ingenious proposal becomes possible: one can emend the name of the otherwise completely unidentifiable “Neocles” to “Clinias.” However, this textual emendation can have no more merit than the assumption that the source for Option A is, in fact, the *Epinomis*. So we first will have to discuss option A and its possible sources.

3 Option A: *Homo numerans*

3.1 *Intellectual Background: Pythagoreans and Plato*

The first possible reason why humans ought to be obeyed more than other animals is that only humans can count (ἀριθμεῖν). This is claimed to be an answer that Plato once gave in response to a certain Neocles. We do not know who this Neocles is, and there is no record of an early member of the Academy of that name. In order to properly evaluate the suggested emendation of “Clinias” for “Neocles,” and the significance of Option A more generally, we should consider its intellectual background.

As Sorabji points out in his seminal study of the ancient philosophical debates concerning human and animal minds, arguments over the distinctness of humans from other animals (and the ethical implications thereof) primarily turned on whether or not animals possess some type of reason or rational faculty and, relatedly, whether or not humans and animals share souls through

¹³ The possibility of “rather than” for μᾶλλον ἢ was suggested to me by Robert Mayhew. I believe it is the preferable translation for two reasons: (1) One might think it strange to be persuaded or commanded by animals to *any* degree. (2) “More than” might be taken to beg the question against the first two options, since they are traits that are either possessed or not, while imitateness varies in degrees.

transmigration.¹⁴ The Stoics and most Peripatetics denied reason to the other animals. It was primarily Platonists who defended the rationality or at least partial rationality of animals.¹⁵ Evidence of numerous subordinate, cognitive and practical capacities or their absence was adduced as a means of establishing animals' (ir)rationality. Such powers included: speech; expressions of friendship or loyalty, courage, justice and other excellences of character; memory and experience-based learning; discrimination between beneficial and harmful objects; foresight or inference; the ability to build nests, hives, webs and the like; and numerous other features.¹⁶ Amongst these debated features were the capacities that we find in Options A, B, and C respectively: to count, to recognize the gods, and to imitate (and thereby receive instruction).

The first of these, the ability to count, is linked to Plato in our passage. Plato does not explicitly claim that only man can count, but it is reasonable to infer that he would agree to such. Because it is the immortal part of the soul, Plato's theory of reincarnation requires him to posit *nous* in animals, albeit in a severely deformed state.¹⁷ Nevertheless, he identified reason as a cognitive faculty which adult humans possess (to varying degrees), but which animals and children lack.¹⁸ Furthermore, Plato granted special importance to the ability to count amongst human cognitive capacities; the fundamentality of the

14 Sorabji (1993, 7–16, 78–93). The presence or absence of νοῦς was used by the Greeks to differentiate between man and beast long before the concept's development and refinement through philosophy. See Hom. *Od.* 10.239–40: οἱ δὲ σῶν μὲν ἔχον κεφαλὰς φωνὴν τε τρίχας τε | καὶ δέμας, αὐτὰρ νοῦς ἦν ἔμπεδος ὥς τὸ πάρος περ. However, speech or knowledge of various crafts were at first more typical differentiae. E.g. *Od.* 5.334 & 6.125. See Baldry (1965, 15). Another early distinction (relevant to Option B) was that humans have laws and justice but beasts (and the brutish Cyclops) do not, e.g. Hes. *Op.* 276–80. Reason would become the focal point of these debates, but speech remained a close second. Cf. X. *Oec.* 13.9; *Cyr.* 8.2.4 (slaves like beasts lacking reason), and Isoc. *Antid.* 253–57, 293–94, *Panath.* 163. See Baldry (1965, 64 & 68–69).

15 Sorabji (1993, 7–8, 78, 103) also identifies the Pythagoreans in this camp. However, this may be inaccurate (*infra* n. 26). The Pythagoreans practiced vegetarianism and other forms of ethical recognition for animals primarily on the basis of their theory of the transmigration of *souls*, which no one doubts, given Xenophanes 11B7 DK. It is a matter of debate whether, additionally, the pain felt by animals was a relevant consideration for the early Pythagoreans; Sorabji doubts this (208–209), while Huffman thinks it plausible (2009, 42–43).

16 Sorabji (1993, 90–91).

17 *Tim.* 41c6–d3, 42b3–d2, 43c4 ff., 69c5 ff., 91d6 ff., 92c1–3

18 *Rep.* 4.441a5–b3, *Laws* 12.963e3–8. The same example is used to show the difference between the spirited and reasoning parts of the soul in the first instance and between the virtues of courage and wisdom or practical reason in the second.

knowledge of numbers in relation to other bodies of knowledge is discussed at length in several dialogues.¹⁹

Plato's development of this theme, especially in the *Philebus*, points to even earlier origins of the view. Therein, the idea is first presented in terms of introducing limits to bring unity and then finite divisions to what is otherwise unlimited phenomena (16d4–e4). Later it becomes clear that above all it is numbers that serve as these limits (25d1–e2, 55e1 ff.). The method of introducing limit (by collection and division) was allegedly a gift to mankind from “Prometheus” (16c5–7); and the initial example of this method's successful deployment is the development of letters by the god or godlike man whom the Egyptians know as “Theuth.”²⁰ However, from Plato's Academy onward the Greek culture-hero most associated with great mathematical discovery was Pythagoras, who is recognized as the intended reference of this “Prometheus.”²¹

It is not surprising that Plato would give this view of the cognitive power of applying *limits* by way of numbers a Pythagorean face.²² In his *Περὶ κόσμου*, Philolaus argued that the world must contain both limiters (περαίνοντα) and things without limit (ἄπειρα).²³ Nothing could be known if everything were to be unlimited: ἀρχὰν οὐδὲ τὸ γνωστούμενον ἐσσεῖται πάντων ἀπείρων ἐόντων.²⁴ This is because things are known and understood through number. Thus things lacking in number (i.e. limit) would be unknowable. Καὶ πάντα γὰρ μὲν τὰ γινωσκόμενα ἀριθμὸν ἔχοντι· οὐ γὰρ ὅτιῶν <οἶόν> τε οὐδὲν οὔτε νοηθῆμεν οὔτε γνωσθῆμεν ἄνευ τούτῳ.²⁵ If the Pythagoreans attributed to animals the kind of

19 *Phlb.* 55e2 ff.; *Laws* 5.737e7–738a2, 746e6–747b6; 7.817e5; 12.967d7–968a4; cf. *Rep.* 530e5–531c4. Number's ability to let us go beyond mere misleading and inexact perception, however, can be found even in early dialogues, e.g. *Prot.* 356d4 ff. where the art of measurement is our salvation.

20 *Phlb.* 18b6–d2. In the *Phaedrus*, Socrates reports that Theuth was also credited with the invention of numbers and the mathematical sciences (calculation, geometry, astronomy) in addition to letters (274c7–d2). Cf. the role of “Thoth” in Aristoxenus fr. 24, *infra*. *Phdr.* 275b3–c4 suggests that Plato doubts the historicity of the Egyptian stories he has Socrates recount, but that he believes them to contain a core of truth.

21 Cf. *Rep.* 7.530d6–e3, where the Pythagoreans are credited with finding a kinship between harmonics and astronomy. This kinship, Socrates explains, is seen through mathematical astronomy and mathematical harmonics, not their empirical, sensuous analogs (531b7–d4).

22 This “Pythagorean” face is based on the Pythagoreanism of the μαθηματικοί of the fifth century, as against that of the ἀκουσματικοί or its initial character in the mid-sixth century.

23 44B2 DK = Stob. 1.21.7a.

24 44B3 DK = Iamb. in *Nic.* 7.24–25.

25 44B4 DK = Stob. 1.27.7b.

intellect necessary for enumeration, then they could have believed animals capable of knowledge and/or reasoning. However, despite the kinship that they recognized between humans and beasts, it is unlikely that fifth century Pythagoreans such as Philolaus posited reason to beasts.²⁶

Some caution is necessary in evaluating pre-Aristotelian positions on the question of animal rationality in general, because of the frequent blurring of lines between different kinds of cognitive faculties. As Aristotle himself complains, many Presocratic philosophers lumped αἴσθησις together with διανοία or νοῦς, or conflated νοῦς with ψυχή.²⁷ A similar point is also applicable to Plato's epistemic category of "opinion" (δόξα). Because they all have sensible objects, Plato's concept of opinion confounds perception with perceptual judgments or perception-based beliefs even though the latter involve the use of concepts and discursive thought while the former do not.

Perception (which all animals possess) and imagination (which some do) are not the same as opinion. According to Aristotle and Theophrastus, opinion implies imagination, but the converse is not true.²⁸ This is why, in his mature thought, Plato could think that animals literally could be brave though not rational, since bravery is the preservation of true opinion in the face of the fearful by the spirited part of the soul.²⁹ Aristotle, however, will only grant that some animals have the "natural virtue" of courage. This is related and analogous to but not the same as the actual virtue of courage, which requires practical reason (φρόνησις).³⁰

26 Contrary to Sorabji's claim (1993, 78), the Pythagoreans probably did not attribute *intellect* to animals. See Huffman (2009: 41–42, 42 n. 59). Similarly, consider Alcmeon 14A5 DK.

27 DA 1.2.404a25–29, b1–6, 3.3.427a20. That all animate beings have intellect: see Anaxagoras 59B11, 12 DK, especially καὶ ὅσα γε ψυχὴν ἔχει καὶ τὰ μείζω καὶ τὰ ἐλάσσω, πάντων νοῦς κρατεῖ. According to him man exceeds and masters the animals by ἐμπειρία δὲ καὶ μνήμη καὶ σοφαί καὶ τέχνηι. Alternatively, man is most intelligent, not *because* of intellect, but because of his hand (A102 = PA 4.10.687a8–12). This view, Aristotle argues, is backwards (687a11 ff.): Human hands are the natural instruments which human intelligence can put to best advantage. Cf. DA 3.8.432a1–2 and Pr. 30.5.955b22–956a10.

28 DA 3.3.427b7 ff., 428a20–22. There, Aristotle is explicit that while other animals have imagination, none have opinions. Theophrastus 301A.225.40–226.43 FHS&G. However, Aristotle does admit that the imagination is difficult to fully distinguish from the other faculties and is especially puzzling when we consider the separability of certain parts of the soul (DA 3.9.432b1 ff.).

29 Rep. 4.430b2–5. See n. 18 *supra*. Laws 12.967d7–968a4 is explicit that animals can possess courage and moderation, but not wisdom.

30 *Infra* n. 36. Cf. the case of the lion HA 8(9).44.629b5ff.

3.2 *Intellectual Background: Aristotle and the Lyceum*

Whether or not animals possess reason and excellences of habit seem to have been topics examined and debated by the members of the early Lyceum. Aristotle denied that animals possess any sort of rational soul. He is quite explicit that they lack understanding (ἐπιστήμη), thinking (διανοία), intellect (νοῦς/νοεῖν), reason (φρόνησις), opinion (δόξα) or conviction (πίστις).³¹ Practically, animals are motivated by appetite, desire, or even spirit, but not reason(ing).³²

Aristotelianism does preserve resources for many cognitive capacities for animals in the absence of reason: All animals possess perceptive souls and thus locomotion, desire, and sense perception of various kinds (but always including touch). Additionally, some animals possess imagination, memory (and with it perception of time), some can learn and teach, and a few even achieve a small degree of “experience” (ἐμπειρία).³³ Consequently, many commentators have detected a tension in Aristotle’s thought about animal cognition and behavior. In books 7(8) and 8(9) of the *Historia animalium*, where Aristotle describes the “characters” and behaviors of animals, he seems to go further in what he posits to them.³⁴ He speaks of animals that appear to have virtues

31 DA 3.3.427b7–9, 13–15, 428a20–25, 429a6–8, and 3.11.434a10–12; *Mem.* 1.450a15–17.

32 DA 3.10.433a11–12, 3.11.434a5–7. Cf. *Pr.* 30.12.956b35–36. *Pr.* 30.12 begins with a question about *akrasia*—“Why is it man, especially, who reasons one way and acts another?”—and ends with the statement that “man lives by intellect for the most part, while beasts do so by desire, spirit, and appetite.” This is noteworthy because the corresponding statement at DA 3.10.433a11–12 follows on the heels of a discussion of how theoretical reason and knowledge is related to motivation and *akrasia*. The analysis in *Pr.* 30.12 has some differences, since it begins by explaining that ἐπιστήμη concerns its subject and its opposite and that νοῦς is of many things, but desire is for only one. The problem is possibly drawing on DA 3.10.433b5–12, which is similar but not identical. The difference is that in the *De anima*, the explanation for opposed desires (in humans) is that possessing *multiple faculties* gives humans differing and potentially opposed sources of desire, while in *Pr.* 30.12 it is that the human faculties or forms of knowledge have *multiple objects* (even opposites), while desire has only one.

33 DA 3.3.428a8–11, 24–25. *Mem.* 1.449b28–30, *Metaph* A.1.980a27–b27. How far these can be taken with respect to what they afford animals is a matter of debate. One recent account salient to this discussion that argues that imagination and experience make animals cognitively continuous with us is Osborne (2007, 85–94).

34 Following Balme (1991, 56), I refer to books of the *Historia animalium* by the original manuscript order. Given parenthetically are the books as they are enumerated in most editions since Theodore of Gaza moved book 9 to after 6.

of habit or intellect.³⁵ They have “natural virtues,” as it were.³⁶ Moreover, the development of these character or “proto-character” traits varies with the intelligence of the animal’s species or even sex (*HA* 8(9).1.608a26 ff.). Attachment to and parental care for their young, for instance is a habit expressed by the *more intelligent* (φρονιμώτερον) animals (*GA* 3.2.753a7–15). However, Aristotle’s official line in the *Historia animalium* is clear: while some traits differ between animals (including man) by degrees, some apparently common traits are only analogous, and this is true especially with respect to intelligence (φρόνησις) and the like.³⁷ Moreover, he avoids speaking of νοῦς in regards to animals rather scrupulously.³⁸

What seems problematic is not so much whether Aristotle is strictly consistent in his direct and explicit attribution or denial of reason to animals, but in the more subtle implications of the continuum between animals and humans that emerges in his thought. Such a continuum seems evident in cases like Option C, since both humans and animals can learn through their varying capacities for imitation.³⁹ But given the separateness, immateriality, and non-naturalness of νοῦς, we might expect a greater gulf between beasts and ourselves.⁴⁰ Meanwhile, other members of the early Lyceum were actively collecting observations of animal intelligence that only served to narrow whatever gap Aristotle’s zoology and psychology had left between man and beast. As such, the topic of animal cognition and its (dis)similarity to the human mind looms large in studies of the early Peripatetics, especially Eudemus, Theophrastus, and Strato. In the latter two cases, this is directly germane to assessing and understanding the extent of their agreements and disagreements with Aristotle on the nature of νοῦς. If they embrace and stress the commonality between animals and humans, then they may do so with a different

35 Key passages are *HA* 588a21 ff., 608a13 ff., 610b20 ff. Additional noteworthy attributions include φρόνιμος for deer and hares (488b15), cuckoos (618a25), and cranes (618b18); φροντιστικώτερον for the males of most species (608b2); and the cognizance (σύνεσις) of elephants (630b21).

36 *HA* 8(9).1.608b4–6 “There are traces of these characters in virtually all animals, but they are all the more evident in those that are more possessed of character and especially in man” (Balme trans.). For natural virtue: *EN* 1111b6–8, 1144b1–16 (cf. *EE* 1233b24–32), 1151a15–19. See also Fortenbaugh (1971), Cole (1992), White (1992) and Lennox (1999).

37 *HA* 7(8).1.588a17–b3, cf. Balme (1991, 58–59 notes b & c).

38 There is only one mention, at *HA* 8(9).3.610b22, which is informal and in contrast to ἄνοιαν (per Sylburg’s edition), Balme (1991, 234–35) does not take this to actually impute intellect to other animals (although he retains the reading as ἄγνοιαν).

39 See §5.2 *infra*.

40 E.g. *DA* 2.2.413b24–27, 3.4.429b4–5; *GA* 2.3.736b27–29.

view of the relationship between intellect and the senses. This is certainly true in the case of Strato, who held that the senses are always conjoined with the intellect and that both have a corporeal basis.⁴¹

The (in)ability of animals to count, and whether or not this is a kind of *knowing*, was one such capacity that came under investigation (and perhaps reevaluation) in the Lyceum. While we find no explicit denial of it, we can safely presume that Aristotle would have denied animals the *knowledge* of how to count.⁴² As we noted in §1.2, there is one passage where Aristotle mentions the claim that knowledge of how to count is definitive of “human” (hence unique). In *Top.* 6.5, while criticizing definitions that lack a genus, Aristotle’s two examples are “what has three dimensions” for “body” and “what knows how to count” (τὸ ἐπιστάμενον ἀριθμεῖν) for “man” (142b25–26). Had the definition been “*the animal* that knows how to count,” Aristotle probably would have still objected to the differentia on various grounds. Yet the use of the example suggests that this was a reasonably familiar idea in the Academy and that thinking of man as the (animal) capable of learning how to count was considered somewhat plausible, though probably less than “a body is what has three dimensions.” Note, though, that Aristotle says ἐπιστάμενον ἀριθμεῖν, just as *Pr.* 30.6 uses ἐπίστασθαι ἀριθμεῖν. This is not a capacity, but a form of knowledge. This makes it a poor definition for “human,” since not all humans know how to count, but it does make for a clear contrast with whatever quantitative abilities animals possess.

We know that Aristotle’s two closest students, Theophrastus and Eudemus, both participated in and extended the project of ethology and animal psychology that we see in *HA* 7(8) and 8(9).⁴³ While we have no fragments that we can definitively tie to it, we know that Theophrastus wrote a book titled: *On the Intelligence and Habits of Animals* (Περὶ ζῶων φρονήσεως καὶ ἥθους) (D.L. 4.49).⁴⁴

41 Regarding the senses and intellect: Strato frs. 61 (cf. 59) & 62 Sharples; cf. Sharples (1995, 40 n. 129) and Fortenbaugh (2011, 405–10). On the connection between soul and body: frs. 56–59, 63 Sharples; cf. Modrak (2011).

42 Against this claim, one might cite *HA* 8(9).48.631a26–27, where Aristotle says that dolphins “hold their breath *as if* they were calculating” (ὥσπερ ἀναλογισάμενοι). Yet (at the risk of special pleading) this seems to be a case of time perception and a kind of cleverness that is distinct from knowing how to count.

43 See Sharples (1995, 32–37). White (2002, 207–208, 216 ff.).

44 This work is sometimes reattributed to Eudemus instead (see White 2002, 216–17), because (1) we know of no obvious title to attach to his fragments concerning animal character or intelligence, (2) we do not have fragments of this kind attributed to Theophrastus, and (3) because other titles on this same list of Theophrastus’ works very likely belong to Eudemus, viz. fr. 133–49. Nevertheless, it is now widely agreed that it was Theophrastus’

Other works by him similarly collected and perhaps analyzed the behaviors of animals and their causes, e.g. *On the Animals that are Said to be Envious* (Περὶ τῶν ζώων ὅσα λέγεται φθονεῖν) (D.L. 4.43).

How far beyond Aristotle Theophrastus went in attributing actual intelligence and capacities *akin to* intelligence is a matter much debated.⁴⁵ The most relevant evidence falls at two extremes. On the one hand, our fragment of the *On the Animals that are Said to be Envious* is a debunking of the appearance of malice or envy of the part of the animals. The behaviors that lead to such characterizations are reanalyzed in a manner that shows that they are not guided by intelligence and thus are not envious because to be so would presuppose that the animals possess an intelligence which they obviously lack.⁴⁶ Here, the remaining animals (λοιπά) are ἄλογα (13, 19) while humans are λογικοί (13). Allegedly “envious” behavior is to be accounted for by fear or some other “natural passion” (πάθος φυσικόν) (14–20). Similar statements are made by Theophrastus in his work *On Animals that Change Color*.⁴⁷

On the other hand, we have statements of Theophrastus quoted in Porphyry’s *De abstinentia* that emphasize the commonality or kinship (οἰκειός, συγγενής) that men have with animals as well as all other men.⁴⁸ These statements, which mostly or entirely come from his *On Piety*, are part of a series of arguments Theophrastus raised against animal sacrifice. In the most important fragment, Theophrastus states that the principles, meaning the homeomerous parts (e.g. flesh, skin), are the same for the bodies of humans and animals. Their souls also do not differ in their natures either: they do not differ in their appetites (ἐπιθυμίαι) and urges (ὀργαί), *nor even in their calculations* (λόγοι),

work, even though the identification of *On the Intelligence and Habits* with HA 7(8) and/or 8(9) is overwhelmingly rejected. See Balme (1991, 7–10) and Sharples (1995, 45–48).

45 Sharples (1995, 39–41) provides a good overview of the issues, and of the debate up to the 1990s. See Cole (1992), Sorabji (1993), White (2002), and Fortenbaugh (2011).

46 Theophrastus 362A.11–4 FHS&G: Ἀλλ’ ὅτι μὲν οὐ διὰ φθόνον ταῦτα ποιεῖ τὰ ζῶα, ἀλλ’ οἱ ἄνθρωποι ἐκ τῆς ἰδίας ὑπολήψεως ταύτην αὐτοῖς περιῆψαν τὴν αἰτίαν, παντὶ δῆλον. Πόθεν γὰρ τοῖς ἀλόγοις ἢ τοσαύτη σοφία, ἣν καὶ οἱ λογικοὶ μετὰ συκνής μελέτης μακθάνουσιν. See Cole (1992, 57–58) and Sharples (1995, 38–40, 71–84).

47 See 365A–D FHS&G. 365D6–9 should not be taken as an exception. In *De sollertia animalium* the character of Heracleon misrepresents Theophrastus in saying that, unlike the chamaeleon, the octopus changes color deliberately, as a tactic. Theophrastus did not think that the octopus changed color by design, but by fear, as Plutarch’s own statements at *Aet.Ph.* 365C evidences. This is a false report that Heracleon uses to prop up his side’s view, i.e. that aquatic animals are more intelligent than terrestrial ones. But see Sharples (1995, 41).

48 Against which, see EN 8.11.1161a32–b3. See Fortenbaugh (1984) and Cole (1992).

and they are most of all alike in having all the same sorts of sense perceptions (αἰσθήσεις).⁴⁹ The claim about λόγοι is quite remarkable, but Theophrastus is probably not going so far as to say that animal souls are the same as human souls. He goes on to clarify that like their bodies, animals' souls vary in the degree of their perfection, though the principles from which they naturally arise are the same.⁵⁰ Still, with respect to their principles or sources, this represents animal souls and human souls as different in degree, not in kind. This is a significant change from Aristotle.

The same general point about human and animal kinship is referred to again later, when Porphyry reports Theophrastus as having said that ancient humans refrained from murder and killing so long as they judged there to be a kinship between themselves and other animals (584A.22.1 FSH&G). (Thus animal sacrifice was not the original form of sacrifice given to the gods.) However, even here other animals are contrasted with humans; they are "the remainder" (τὰ λοιπά), and the difference is that the remainder are those without reason (ἄλογα).⁵¹

Different scholars lean towards one way of understanding Theophrastus or the other, and while we cannot resolve this question, nor even describe it in full, it is worth observing that it is in *On Piety*, where Theophrastus is arguing against animal sacrifice (and where it is often difficult to disentangle Theophrastus' words from Porphyry's), that we find the most anthropomorphizing of his statements; whereas in the fragments from his biological works

49 531.14–19 FHS&G = *Abst.* 3.25.3.

50 Lines 22 ff. (3.25.4), which are sometimes excluded from the fragment and treated as Porphyry's synopsis, put the point conditionally: "If what we said is true, so that the generation of habits is the same, with all races (ἅπαντα φύλα) reasoning, but differing in upbringings and in the mixtures of primaries, then the genus of the remaining animals *would* be altogether familiar and akin to us." The translation in FHS&G renders ἅπαντα φύλα "all races (of living creatures)," but this may not be correct: the return to mentioning upbringing and habit seems to hearken back to previous argument for the unity of all races of men at ll. 9–12 that was extended, by analogy, to animals. Thus ἅπαντα φύλα could be all the races of men, as distinguished from the class of all the *remaining* animals. The idea is that if all men are the same, then we are akin to animals as well, but it does not mean that all animals possess reason.

51 λοιπά at 22.1.192 and 22.3.204—identified as ἄλογα at 22.2.199. The term λοιπά is used thereafter at 23.2, 24.2, 26.4.5, 27.3, and 28.2. See Fortenbaugh et al. (1992, 2: 417 n. 5). Sorabji (1993, 46) takes the use of ἄλογα in Theophrastus and in Eudemos (fr. 130 Wehrli, *infra*) as relatively insignificant. On his reading, ἄλογα has simply become synonymous in Aristotle's school with "beasts," thus it only denotes animals, without committing Theophrastus or Eudemos to the view that these animals lack reason. But this seems to miss the μέν—δέ force in Eudemos fr. 130.

he consistently denies animal rationality and consistently accounts for *seemingly* intelligent behavior in terms of natural passions such as fear. Even when no immediate alternative explanation presents itself, Theophrastus still thinks that we should assume that there is one and not conclude that the animal acts with foresight (362A19–20 FHS&G). Finally, while λόγοις and φρονούσι in fr. 531 FHS&G are rather remarkable, Theophrastus might be emphasizing his point in regards to the ἀρχαί of animal bodies and souls.

Judging from what little we have, Eudemus seems to fall somewhere in between the two extremes found in Theophrastus' work.⁵² A number of accounts by Eudemus reporting remarkable animal behavior are preserved in Aelian's *On Distinctiveness in Animals* (Περὶ ζώων ιδιότητος). Most of them are fabulous tales describing acts of friendship or cleverness by animals, but the most significant of these and the most relevant to Option A discusses animals and counting. Aelian reports that according to Eudemus, "(some) animals, even though they are without reason, have a nature that is numerate without any instruction."⁵³ Eudemus' evidence for this claim, according to Aelian, was a certain unnamed Libyan animal, which divides its food into 11 pieces, eats 10, and leaves the remainder as a "first fruit" or "tithe," "for whose benefit, from what (cause), and with what intent it is well-worth investigating." The implication, perhaps, is that this Libyan animal worships the gods as well, which, if true, would put the lie to the *Homo venerans* view as much as the *Homo numerans*.

We are justifiably amazed by this "self-taught wisdom," that an irrational animal should know one, two, and the following numbers, when it takes so much education to teach these things (or even to fail to do so) to humans.⁵⁴ It is questionable whether Eudemus countenances this story at all: it is extremely unusual that no animal is named, and the other stories that Aelian quotes from Eudemus range from fantastic *mirabilia* (3.21, 4.8, 4.45 = frs. 127, 128, 129) to anecdotes unremarkable with respect to challenging our assumptions about animal cognition (3.20, 4.56, 5.7 = frs. 126, 131, 132).⁵⁵ If Eudemus does think

52 White (2002, 217 ff.).

53 4.53 = fr. 130 Wehrli. Εἶναι δὲ ἄλογα μὲν ζῶα, φυσικὴν δὲ ἔχειν ἀριθμητικὴν μὴ διδασθέντα.

54 4.53 = fr. 130 Wehrli. οὐκοῦν ἐκπλαγῆναι δίκαιον τὴν αὐτοδίδακτον σοφίαν <τὴνδε> τὴν γὰρ τοι μονάδα καὶ δυάδα καὶ τοὺς ἐξῆς ἀριθμοὺς ζῶον οἶδεν ἄλογον· ἀνθρώπων δὲ δεῖ πόσων μὲν τῶν μαθημάτων, πόσων δὲ τῶν πληγῶν, ἵνα ἢ μάθῃ ταῦτα εὖ καὶ καλῶς ἢ πολλάκις μὴ μάθῃ; Cf. *Pr.* 15.3, which ends by saying that some Thracians count in units of four (rather than in base 10) because "just as with children they are incapable of remembering for much time (ἐπὶ πολὺ), and they make little use of plentitudes (μηδὲ χρῆσιν μηδενὸς εἶναι πολλοῦ αὐτοῖς). (My thanks to Robert Mayhew for this point.)

55 See Sorabji (1993, 46, 90–93), Preus (1991), and White (2002).

this credible, then the last lines seem to be at least a little tongue-in-cheek and recall Theophrastus' words in 362 A FHS&G: Πόθεν γὰρ τοῖς ἀλόγοις ἢ τοσαύτη σοφία, ἣν καὶ οἱ λογικοὶ μετὰ συχνῆς μελέτης μανθάνουσιν.

However, a numerate nature is really not the same thing as being instructed; there is a distinction, even for animals, between teaching and nature. One could argue that having such autodidactic wisdom (αὐτοδίδακτον σοφίαν) is consistent with μὴ διδαχθέντα, stressing that this is passive (being taught by another). But this seems quite a stretch. It remains "astounding" that an animal should learn these things by itself. What might be possible is that it naturally can divide its food up by a certain number or can naturally track certain numbers. Thus φυσικὴν δὲ ἔχειν ἀριθμητικὴν would be quite different from (δύναται) ἐπίστασθαι ἀριθμεῖν.

So it is possible that among early Peripatetics there were those who disputed the inability of animals to make quantitative discriminations, but they did not deem this equivalent to granting to them reason or a uniquely human level of knowledge. Thus Option A would not be controversial in the Lyceum if one were to emphasize that only man *knows* how to count (ἐπίσταται ἀριθμεῖν). What would be controversial is how definitive and fundamental this attribute is, how central it is to practical reasoning, and whether there are any cases of counting among animals in a less conceptual, analogous sense.

3.3 *The Epinomis and the Reading of 'Neocles' or 'Clinias'*

This background should be taken into account when we reflect upon whether Option A is (or can *only* be) a reference to the *Epinomis*. When we do so, we find that the *Epinomis* is following in an early Pythagorean-Platonic tradition on questions of the knowledge of number. While the *Epinomis* is probably the oldest explicit statement of the full *Homo numerans* viewpoint that we find in Option A, it does not originate it.

The *Epinomis* presents itself as the continuation of the topic taken up but left unfinished in the twelfth and final book of Plato's *Laws*: what kind of knowledge (of a divine sort) is wisdom, such that the members of the nocturnal council must possess it. Earlier in the *Laws*, the mathematical sciences of arithmetic, geometry, and astronomy are characterized as prerequisites for the attainment of this divine knowledge (7.817e5 ff.). Anyone who knows "the most beautiful sciences" and is capable of ruling men must also know these "necessary" branches of mathematics (7.818b9–e2, 12.967e1–4). Book 12 (966c1 ff., 967d4–e2) adds that the rulers will need to learn the kind of theological proofs discussed in *Laws* 10. Most importantly, they will need to be able to discover the one unifying form among an indefinitely large many, and to

distinguish between the finitely many subtypes within that form—i.e. dialectic (12.964a5–b1, 965c1–6).⁵⁶

The *Epinomis* begins with the Athenian Stranger, Clinias, and Megillus reconvening at a dramatic date later than the *Laws*. Their purpose is to fulfill their promise to complete the discussion of the most divine kind of wisdom (σοφία) at some later date (973a1–b6). (Of course, no such promise is actually made in the *Laws*.)⁵⁷ This wisdom will turn out to be mathematical astronomy of the visible heavens. We get an argument similar to the one from the end of the *Philebus* that there would be no other arts worthy of the name without the knowledge of number (971c1 ff.). What is further claimed, however, is that: (1) the capacity for knowledge of number was given by god to man, but not to other animals (977c1–d1, 978b9–979a1), (2) number was learned from observing the heavens (978b7–979a6, 988a8–b7), and (3) mathematical astronomy is σοφία (989a6–b2, 989e1–990b4). Number is not only learned from the planets, this knowledge (and the knowledge of arithmetic and geometry that build upon it) opens up mathematical astronomy in turn. Since this knowledge is identified in the *Epinomis* as *wisdom* in the truest sense, it will be necessary for complete virtue, and possession of it will, presumably, make one more πιστότεον. Ultimately, man's unique knowledge of number among the (less than daemonic) animals is a necessary and central reason for why he ought to be obeyed rather than them. Thus we have a view that could match the description in Option A.

We have surveyed the Peripatetic views that can best inform us about what the author of *Pr.* 30.6 might have made of Option A, and we have looked at views in the Pythagorean-Platonist tradition up to and including the *Epinomis* to see if the views in the latter (and only they) are the intended reference in Option A. With that in mind, we return to the question of reading “Clinias” for “Neocles.” Since there are no manuscript variants with respect to Νεοκλεῖ, let us first consider the reasons for preferring emendation. If we read Κλενίξ for Νεοκλεῖ, then we are saying that this is a reference to the *Laws* or *Epinomis* in which the character of Clinias of Crete is the Athenian Stranger's principle interlocutor. Despite stressing the essentiality of a basic mathematical education for all free citizens and an advanced one for all rulers, nowhere in the twelve books of the *Laws* is Clinias told by the Stranger than only man knows how to count. We did, however, find such a claim, more or less, in the *Epinomis*. So, previous commentaries that ask us to compare option A to the *Epinomis*

⁵⁶ See Tarán (1975, 28–30).

⁵⁷ Tarán (1975, 23).

are right. The latter is helpful as a presentation of one possible way of developing this theme within a loosely Platonic framework. But we should do no more than that. “Clinias” is a reasonable conjecture, and its consideration is edifying. In the final analysis, though, it should be rejected and the manuscript reading retained. While we cannot be absolutely certain, I think we can conclude with reasonable probability that this is an anecdote about Plato, not an allusion to the *Epinomis*.

While the texts are a fairly close “doctrinal match,” as it were, there still are (at least) three important problems with taking “as Plato answered [Clinias]” to refer to this passage of the *Epinomis*. First of all, it must be plausible that the author or a later scribe would confuse the one name for the other. It is not implausible that the author’s memory slightly misfired, giving him a rough spoonerism that inverted the KA with the N and then turned NK*Λ into a familiar Greek name fitting those conditions: NEOKAEI (“Neocles” in the dative). This is pure speculation, but it is an understandable and in no way extraordinary scenario.⁵⁸ It also could have been the result of a comparable slip-up at the scribal level. This would also be reasonable, as the lengths of KAINEIAI and NEOKAEI are nearly equal.

The other two problems are a bit trickier. In the anecdote or allusion referred to in Option A’s gloss, it is Neocles or Clinias, respectively, who is the questioner and Plato, in either case, who is the respondent. In the *Epinomis* it is the Athenian Stranger, not Plato, who answers the questions (usually his own). How, then, can this be an allusion to the dialogue between the *Athenian Stranger* and Clinias rather than an anecdote of an exchange between *Plato* and Neocles?

Confusions or disagreements about the identity of the Athenian Stranger or the way to refer to him were not unknown in the Lyceum and subsequently in antiquity. Aristotle, (in)famously refers to the inadequacies of the accounts given in the *Laws* by *Socrates* (*Pol.* 2.6.1265a11,29, b19). Perhaps it was a gaffe; or perhaps it was a keen hermeneutical insight. Others identify the character of the Athenian stranger as Plato himself, rather than Socrates. Cicero certainly held this view (*Leg.* 1.5.15).⁵⁹ Alternatively, it is possible to simply slip

58 To take an example close to the Lyceum, consider Aulus Gellius’ “Menedemus” for “Eudemus” in *Att.Noc.* 13.5.

59 Note that the character of M. Tullius Cicero, in a dialogue that Cicero himself wrote, puts it thus to Atticus: *Visne igitur, ut ille [Platon] cum Crete Clinia et cum Lacedaemonio Megillo aestiuo, quem ad modum describit, die in cupressetis Gnosiorum et spatiis siluestribus, crebro insistens, interdum adquiescens, de institutis rerum publicarum ac de optimis legibus disputabat.* Thus if Cicero were to describe the passage of the *Epinomis*—which

into speaking of Plato, the author, as putting forward this or that view in reply to a question. Aristotle does so almost immediately after ascribing the same accounts to the character of Socrates (*Pol.* 1266b5).⁶⁰ When we keep all of this in mind, the second problem turns out to have less bite to it.

But there is still another problem, and it is much more intractable. Even if, for the sake of argument, we can call the stranger in the *Epinomis* (or the author of his lines) “Plato,” this Plato does not express the *Homo numerans* view as the *answer* to any *question*. At the point at which the human capacity to learn of numbers is first stated explicitly, the Athenian Stranger has been speaking almost without interruption for all but the first few words of the dialogue. Clinias had a few opening remarks to set the scene, but he asked no questions. In fact, in the entire “dialogue” Clinias only asks one question—“what do you mean?”—and the Stranger promptly elaborates (986a7).

Finally, we must contend with the fact that the *Epinomis* is not Plato’s (or at least it is now predominately regarded as being spurious).⁶¹ That fact, on its own, does not weigh for or against regarding this as a reference made to the *Epinomis*. What would matter is if the author of our problem knew that “Plato’s *Epinomis*” was pseudonymous. Suppose he did, and yet still referred to Clinias’ respondent as “Plato.” He would have had to continue thinking of the character of the Stranger—even in a different author’s hands—as Plato. This is not impossible, but it is highly implausible: to refer to a view in the *Epinomis* by the locution “Plato says” or “Plato answers,” he would not only have to be aware of the *Epinomis* but also, presumably, think of it as being written by Plato. Alternatively, he would have had to share a Ciceronian view, wherein the character of the Stranger in the *Laws* just is Plato, and transferred this secret identity over to the Stranger in the *Epinomis*. But this is equally bizarre.

Indeed, we must ask whether the author of *Pr.* 30.6 would have known of the *Epinomis* at all. The oldest extant reference to the *Epinomis* at all is a report on the edition of Platonic trilogies made by Aristophanes of Byzantium, specifically the third trilogy: *Laws*, *Minos*, *Epinomis* (D.L. 3.61–62).⁶² Since

he regarded as authentically Plato’s—he would say it in some such form as: “as Plato says to Clinias.” For Cicero on the *Epinomis*, see *Ora.* 3.6.20–21.

60 *Pol.* 2.9.1271b1 could be offhandedly referring to Plato as the author of some of the Stranger’s anti-Spartan arguments, but it can also be read as identifying Plato with the character of the Stranger.

61 Taken collectively, Tarán’s arguments for spuriousness on internal, doctrinal grounds are decisive (1975, 24–47).

62 Tarán (1975, 3–4) believes that there might be an earlier reference to the *Epinomis* in a fragment of Aristoxenus’ *Περὶ ἀριθμητικῆς*: Αἰγύπτιοι δὲ Ἑρμοῦ φασὶν εὐρημα, ὃν καλοῦσι Θῶθ· οἱ δὲ ἐκ τῶν θείων περιφορῶν ἐπινοηθῆναι (fr. 24 Wehrli). Tarán claims that while this could be

Aristophanes of Byzantium is dated to roughly 257–184, his arrangement of the dialogues into trilogies was probably no earlier than the end of the third century. That would be at least a half of a century after Strato's death, and almost surely no earlier than in the scholarchy of Aristo of Ceos (which began circa 225 BCE). The oldest unambiguous attribution of the work to Plato is even later, in Cicero (*Orat.* 3.6.20–21).⁶³

Assuming that this problem was written in the second half of the fourth or in the first third of the third century BCE, our passage would be the oldest attribution of authorship to Plato, and, indeed, the oldest reference to the *Epinomis* altogether. Therefore, if we read “Clinias” here, taking it to be a reference to the *Epinomis*, and if, furthermore, we take “as Plato answered” to indicate an ascription of the work to Plato (which is logical), then this will have the effect of pushing back the earliest reference to the *Epinomis* by more than half a century, and the earliest attribution of it to Plato by several centuries. This in turn would make the external evidence for the authenticity of the *Epinomis* much stronger. We have a problem of circularity if we are to try to use either the *Epinomis* to date *Pr.* 30.6 and fix its reference or to use the problem to help date the composition of the *Epinomis* or the time of its acceptance into the Platonic corpus. However, we can render a verdict on the *Epinomis*' spuriousness by reference to its internal content, and, once athetized, we can use that spuriousness as leverage for how we read *Pr.* 30.6. On the whole, this is another reason *not* to take this as a reference to Clinias in the *Epinomis*.

Simply put, we should retain the manuscript reading Νεοκλεῖ and regard the gloss to Option A as an anecdote about Plato and Neocles, ὅστις ποτ' ἐστὶν (Aeschylus *Ag.* 160). We do not know whether this really happened or what it was that Neocles asked Plato. Perhaps he asked him the same question as our problem, but probably not. Being an anecdote *is* a weak sort of evidence for the earliness of the problem's composition. It *might* mean that this was a remembrance of Aristotle or Theophrastus, or an anecdote that they shared with their students. We have examples of such. Take Aristoxenus' report of

a reference to *Tim.* 47a1–7, it is more plausible to suppose it to refer to the *Epinomis*. This is incorrect. Aristoxenus might not be referring to a philosophical work at all—οἱ δὲ may be referring to the Syrians or Chaldeans who looked to their astrological gods—but if he is, there is no reason not to take it to be a reference to *Tim.* 47a1–7.

63 Aristophanes' placement of the *Epinomis* in a trilogy is not unambiguous evidence. At minimum, this shows only that it was regarded as part of an established body of Platonic writings or a curriculum (*op. cit.*, 5–7). Even if he did take it to be authentic, Aristophanes “should not be considered a reliable witness in so far as the authenticity of the Platonic canon is concerned,” for he also included the *Minos* and several of the *Epistles*.

Plato's infamous lecture on the Good: he knew of it, we learn, because Aristotle was fond of recounting it (ἀεὶ διηγείτο) as a cautionary tale about the dangers of not providing a summary outline at the start of a lecture (*Harm.* 2.30–31). If Plato's reply to Neocles was an anecdote that Aristotle was fond of telling or an event that stuck in his mind, we would expect him to have referenced it from time to time. Seen in this light, the definition of ἄνθρωπος as τὸ ἐπιστάμενον ἀριθμεῖν mentioned in the *Topics* can be read as a very small piece of abductive evidence for the “anecdotal” interpretation of our text.

4 Option B: *Homo venerans*

4.1 Sources

Another contested part of the cognitive landscape in the debates over animal rationality was the recognition of the gods. In fifth-fourth century Greek thought, amidst the growing body of xenography and the escalating debates that swirled around the νόμος/φύσις distinction, one significant trope that developed was the idea that a small, select number of laws or customs (νόμοι) were more than merely conventional or customary (κατὰ νόμον) in virtue of being universal among all human societies. In Xenophon's *Memorabilia*, Hippias the Sophist and Socrates show their familiarity with this concept, which is known to them as “unwritten laws” (ἄγραφοι νόμοι) (4.4.19). These include the honoring of parents and the incest taboo, although the latter case is debated. Demosthenes, in his *On the Crown*, identified among these universal, unwritten laws the recognition of the distinction between voluntary and involuntary wrongs (274–75). A similar distinction between local, written law and universal, unwritten law is invoked by Aristotle (*Rhet.* 1.10.1368b8–10; 1.13.1373b1–18, 1374a18–28).

Two sources are claimed for these unwritten laws. Unwritten laws are credited to a divine source in Sophocles' *Antigone* (446–60) and in Ps.-Archytas.⁶⁴ Similarly, according to Xenophon's Hippias it is the gods who give to men their unwritten laws (*Mem.* 4.4.19). His evidence for this claim is that foremost among these “unwritten laws” is: recognition and respect for the gods. Alternatively, universal, unwritten laws are thought to arise from some common conception or a natural cognitive capacity among men.⁶⁵ Aristotle thinks that the universal recognition of the gods depends on a common apprehension; he claims in *Cael.* 1.3 that all men, Greeks and Barbarians alike, have some

64 Stobaeus 4.1.32. *Antig.* 456–57 is quoted at *Rhet.* 1.13.1373b11–12.

65 So Demosthenes, *On the Crown* 275.

apprehension (ὑπόληψις) of the gods' existence and their association with the deathless heavens.⁶⁶

This claim—that all men recognize the gods—became so common and so well believed in the fifth and fourth centuries BCE that both the Epicureans and the Stoics counted universal assent (or “common notions”) arguments among their proofs for the existence of gods.⁶⁷ Closely associated with the claim that all men recognize the gods was an additional claim, the *Homo venerans* position of Option B, that humans are distinguished from all other animals by their recognition of the gods and that this accounts, at least in part, for their superior authority with respect to proper action. If the gods are seen as the ultimate source of human law, justice, and/or technical expertise, then a straightforward explanation of the brutishness of animals' existence could be their lack of recognition of the gods. Judging by where we find the *Homo venerans* view reported, it seems that it had some currency among the sophists of fifth century Athens, the Socratic movement, and later the members of the Academy and Stoa. For example, it occurs twice in Plato's early dialogues: once in the mouth of Protagoras, during his myth about Prometheus' common gift of rationality to man, and once from Socrates himself in the *Menexenus*. Protagoras claims that man alone believes in the gods and consequently worships them because he has a share in the divine portion that is reason (*Prot.* 322a3–5), while Socrates states in his funeral oration that among the animals, man alone possesses justice and believes in the gods (*Menex.* 237d6–e1).

4.2 *Homo venerans* as *Homo astrologans*—*Mathematical Astronomy and Theology*

We also find a clear statement of the *Homo venerans* view in Xenophon's *Memorabilia* 1.4, a chapter famous for its intelligent design-based theology and its anthropocentric teleology. Countless natural features of the cosmos and of human nature are interpreted as having been devised by the god(s) for the sake of human well-being. This body of evidence is used to prove that the gods devote much care to men, which in turn means that one ought to piously mind them.⁶⁸ Only human bodies have been given upright posture, allowing us to better contemplate the heavens (τὰ ὑπερθεῖν μάλλον θεᾶσθαι), hands, and a tongue capable of speech (1.4.11–12). Furthermore,

66 *Cael.* 1.3.270b4–11. Cf. fr.10 Rose³ = Sex.Emp. *Adv.Phys.* 1.20.

67 Epicureans: D.L. 10.123, Cic. *ND* 1.16.43–17.44. Stoics: Cic. *ND* 2.4.12; Plut. *De not. com.* 1075e. Common recognition of the gods and the argument for universal assent, generally: Sext. *Emp. Adv.Phys.* 1.32–33; 1.61–62.

68 Cf. Baldry (1965, 90, 164–65).

It was not just man's body that god took care of. More importantly he also engendered in man the greatest soul, for, firstly, what other animal has perceived that there are gods who arranged the greatest and most beautiful things? And what other species than man worships the gods? (1.4.13)

Xenophon's Socratic writing on this subject would continue to be an influence for the Stoics, as would Plato's.⁶⁹

This passage also points to the way that philosophers from at least the early fourth century onward developed the *Homo venerans* theme vis-à-vis astronomy. Man alone can gaze at and study the heavens, for he alone is bipedal and upright, rational and scientifically inquisitive, mathematically competent to perform astronomy, etc.⁷⁰ This contemplation of the planets and stars reveals the gods. For, firstly, the heavenly bodies are themselves divine, and, secondly, it becomes evident upon observing and properly describing the perfect orderliness of the celestial motions that they are the work of intelligence, for only gods could create and/or maintain the perfectly rational motions of the heavens.⁷¹ The Academics, Peripatetics, and Stoics all agree, in some form, that astronomy leads us into philosophical (as against popular) theology.⁷²

So, an astronomical and thus *mathematical* capacity and the capacity to *identify* the celestial gods of the philosophers turn out to be one and the same. However, that does not prove that this is what *fundamentally* sets us apart from animals.⁷³ It certainly does not show us that our knowledge of the gods is the *sine qua non* of whatever it is that makes us *παιστέον*. Perhaps we might try to emulate the rationality of the celestial or super-celestial gods, as Plato and Aristotle were wont to think; but at least in the Aristotelian case, this theoretical

69 See Cic. *ND* 2.6.18. Cf. Sedley (2005).

70 X. *Mem* 1.4.11; Pl. *Tim.* 45a1–2, 46e7–47a7, 90a2–b1. Arist. *PA* 4.10.686a26–28: “For [man-kind] alone of the animals is upright, on account of the fact that its nature and substantial being are divine; and it is a function of that which is most divine to reason and think.” From this point it is further argued that men have hands because they are most intelligent, not the reverse (see n. 27 *supra*); but human hands are the most versatile of instruments “For the most intelligent animal would use the greatest number of instruments well, and the hand would seem to be not one instrument, but many; indeed it is, as it were, an instrument of instruments” (687a17–20). (Translations from the *Parts of Animals*, here and elsewhere, come from Lennox (2001).)

71 *Laws* 10.893b–898c; Cic. *ND* 2.56.140, 61.153–62.155.

72 Cf. Cic. *ND* 1.13.34–35.

73 There are numerous arguments that if one recognizes the gods one must possess reason, but there is only one place where we get the converse: that if one possesses reason one must recognize the gods, namely Plutarch's *Gryllus* 992e.

aspiration will not suffice for practical wisdom. Moreover, not necessarily everyone in the Academy and Lyceum conceded the *Homo venerans* view.

4.3 *Counter-Evidence in Natural History*

Not all natural philosophers agreed that humans were the only animals to recognize and give honor to the gods. According to Clement of Alexandria, Xenocrates held out some hope that other animals might recognize them.⁷⁴ And there were numerous accounts in ancient natural histories (often drawing heavily on Peripatetic sources) that report worship of the gods by elephants and, in one case, tigers.⁷⁵ Elephants were the favorite example. Lengthy versions of the account that are particularly valuable can be found in Ael. *NA* 7.44 and in Plin. *HN* 8.1.1–3. In both, the principle evidence of this is that elephants seem to salute the new moon as well as the (rising) sun. Other evidence—including the offering of plants to the heavens when close to death—are given by Pliny. We noted in the previous section that the Eudemian report of an unnamed Libyan animal that has a numerate nature also hinted that the creature divided up its food into eleven pieces in order to offer a share to the gods, and so it is worth noting the similarities between the sardonic line at the end of Ael. *NA* 7.44 (ἐλέφαντες μὲν οὖν θεοὺς προσκυνοῦσιν, οἱ δὲ ἄνθρωποι ἄρα [εἰ] γε εἰσὶ θεοὶ καὶ ὄντες εἰ φροντίζουσιν ἡμῶν διαποροῦσιν) and the similar one at the end of 4.53 concerning the difficulty of teaching numbers to humans, as well as the parallel line from Theophrastus' *On the Animals that are Said to be Envious*.⁷⁶ In light of those parallels and the hint concerning the Libyan animal, it seems not improbable that Peripatetic natural histories would have included one or more reports of animal worship. These tart lines would seem to imply disbelief, but it is not impossible that one or more Peripatetic took seriously the idea that some animals, particularly elephants, had some kind of “natural virtue” analog of piety.⁷⁷ These views might seem absurd to us, but it is well-worth noting that close analogs persist in the present day. Sperber famously reported that the Dorze Copts of Ethiopia hold that “the leopard is a Christian animal.”⁷⁸ Far more widespread in the west, though, is the popular belief that elephants

74 Clem.Al. *Strom.* 5.13 = Xenocrates fr. 21 Heinze (220 Isnardi).

75 According to Philostratus (*VA* 2.28), tigers were thought by the Indians of Taxila to raise up their paws to the rising sun when they are born. (Since surely not all tigers are born at daybreak, this seems to be a claim of *innate* rather than learned piety).

76 See notes 46 and 54 *supra*.

77 Especially given Aristotle's praise of elephants at *HA* 8(9).46.630b18–22.

78 Sperber (1975, 93), says that they treat this as a literal statement. The Dorze claim that the leopard keeps the Coptic fasts and will wait to eat an animal that they have killed on a fast day.

practice ritual burial.⁷⁹ Had the Greeks heard such stories, many of them, though not Aristotle, would have ascribed piety to the pachyderm without hesitation.

5 Option C: *Homo imitans*

5.1 Sources

The last option is *Homo imitans*. For reasons discussed above in §1.1, it appears to be the option that the author favors. Moreover, it is the answer that is most obviously drawn from Aristotle's work. In the *Poetics*, Aristotle observes that there are two natural causes for the development and practice of poetry: humans are naturally the most imitative of animals and humans seem to naturally take pleasure from representations (even the representations of things that are inherently unpleasant).

Ἐοίκασι δὲ γεννηῆσαι μὲν ὅλως τὴν ποιητικὴν αἰτία δύο τινές καὶ αὗται φυσικαί. τό τε γάρ μιμείσθαι σύμφυτον τοῖς ἀνθρώποις ἐκ παίδων ἐστὶ καὶ τούτῳ διαφέρουσι τῶν ἄλλων ζώων ὅτι μιμητικώτατόν ἐστι καὶ τὰς μαθήσεις ποιεῖται διὰ μιμήσεως τὰς πρώτας, καὶ τὸ χαίρειν τοῖς μιμήμασι πάντας. (*Poet.* 1.4.1448b4–9)

Imitation is connate in humans from our childhood, and we differ from the other animals in so far as we are the most imitative (μιμητικώτατον). The first lessons that we learn are made (ποιεῖται) through imitation.

There can be no reasonable doubt that this is the passage inspiring Option C. There are scarcely more than a dozen known instances of comparative or superlative forms of μιμητικόν in the entire Hellenic corpus. None occur before Aristotle, while the adjective μιμητικόν was itself probably Plato's invention. Plato only uses the term in reference to the imitative arts or the art of imitation.⁸⁰ The only other comparable use of μιμητικώτατον is Aristotle's related claim in the *Rhetoric*: poets (i.e. imitators) began oral delivery for the very natural reason that words are imitations, and "the voice is the most

79 While tales of elephant graveyards remain wholly unsubstantiated, scientifically reputable findings concerning elephants showing heightened interest in the remains of their own dead have been published in the last decade. See McComb et al. (2006, 26–28). Robert Mayhew has rightly pointed out to me that respect for dead is not necessarily religious; he suspects that, in the case of elephants, their respect for the dead is secular.

80 It is used in the typical Platonic fashion in the *Epinomis* (975d2, 9).

imitative of all of our parts” (ἡ φωνὴ πάντων μιμητικώτατον τῶν μορίων ἡμῖν, *Rhet.* 3.1.1404a22). Additionally, the *Poetics* passage is explicit that it is in this way that *we differ from other animals*, even from childhood.

5.2 *Animals Teach and Learn—the Connection between the Senses, Imitation, and Learning*

Perhaps what is most interesting about this answer being selected over the previous options is that the trait that it identifies is *not* unique to humans; it is simply one in which humans handily surpass all other animals. At *HA* 8(9).1.608a17–20, Aristotle observes that some animals share in *learning* (μαθήσις) and *teaching* (διδασκαλία). Some can be taught by humans, and some can teach one another. This is much in keeping with Aristotle’s observation at *GA* 3.2.753a7–15 that the care for the young increases with a species’ level of intelligence, as such care would include a kind of instruction. Such receptiveness to instruction depends, he says, on memory, being able to hear sounds, and the crucial ability to perceive the differences between different signs, i.e. a discriminatory capacity (608a20–21).⁸¹

Learning seems to be concomitant with mimicry, which itself varies with both the ability to discriminate between different sounds and to *replicate* these differences by articulating sounds. Imitation involves not only observing the object to be imitated but also reproducing (a resemblance of) it or its salient features. Therefore, learning—which *requires imitation*—will need both hearing sounds discriminately and vocalizing them articulately (*DA* 3.13.435b24–26).

This is implied when Aristotle points out that being able to mimic (μιμητικόν) is a feature of all the crooked-taloned birds (γαμψώνυχα), “as they are *short-necked* (βραχυτράχηλα) and *flat-tongued* (πλατύγλωττα).”⁸² Being short-necked serves in the cause of mimicry: having a neck occurs only when an animal is in need of a larynx and/or oesophagus, and in the case of the cartilaginous larynx and windpipe “not only are they for the sake of breathing, but also for the sake of vocalizing” (*PA* 3.3.663a35–b1). The shape (and softness) of the tongue is even more important. The flatness of the tongue is one of the key features necessary for the production of well-articulated sounds (*PA* 2.17.660a18–23, 29–30). As a result of their broad tongues, the crook-taloned birds are especially

81 At *Metaph.* A.1.980b22–25, he identifies hearing and memory as prerequisites for the species to be able to learn. Animals with memory are more intelligent (φρονιμώτερα) and better able to learn (μαθητικώτερα) than those without it, but while some deaf animals, such as the bee, are intelligent (φρόνιμα), they lack the power to learn, as this requires the hearing of sounds (ψόφων ἀκούειν) in addition to memory.

82 *HA* 7(8).12.597b25–26.

communicative. All birds use their tongues to make “expressions” (ἐρμηνείαν) to one another, but some so much so that there “seems to be instruction (μάθησιν εἶναι δοκεῖν)” amongst them (2.17.660a33–b2).⁸³

Humans far outstrip even mimicking birds with their unique lips and tongues; ours by nature are meant not only to protect the teeth or to taste food, but also to make articulate sounds (PA 2.16.659b30–660a8). More importantly, only humans possess speech in the rational sense. Other species, he says in the *Politics*, have voices with which they can express pain and pleasure to one another, but only human speech can express what is harmful and beneficial, as only humans can perceive good and bad, just and unjust (*Pol.* 1.2.1253a9–19).

Human beings are the only animal to possess νοῦς, but at our births we are devoid of any actual rationality, possessing only its potential.⁸⁴ However, humans are the most perceptively acute or sensitive of animals. Aristotle claims at DA 2.9.421a18–26 that it is our greatest sensitivity to touch that makes us the most intelligent (φρονιμώτατον) of animals.⁸⁵ But the senses and intellect are not the same. How does greater acuity in the one lead to unique achievements in the other? Here, imitation is the middle term, as it were. Our greater sensitivity makes us far better able to observe, discriminate, and articulate movements and sounds. This makes us the most imitative animal, and as *Pr.* 30.6 puts it: μαθηθῆναι γὰρ δύναται διὰ τοῦτο. Therefore, we are the animal most capable of learning and teaching. It is in this way that we become most intelligent. And if we are the most intelligent in both the practical and theoretical senses, we will be the mortal animal that ought to be obeyed most.

6 Conclusions

There are a few things that we can conclude about this passage, but little that is both certain and precise. Given the intellectual background we have considered, it would seem that by the time of the Early Lyceum all three options were well-trodden paths. The origins of the first option were to be found in Plato's fifth century Pythagorean influences, and those of the second option in the Athenian enlightenment and the Socratic movement especially. Both were

83 Cf. HA 1.1.488a31–b1, which claims the singing (ᾄδειν) and chattering (λαλεῖν) has mostly to do with mating.

84 At first we are like animals: EN 1.9.1099b32–1100a5; 3.1.1111a24–26.

85 Cf. PA 2.16.660a9–13: Humans are the most perceptively of animals (αἰσθητικώτατον εἶναι τῶν ζώων) because our flesh is softest. Moreover, as taste is a kind of touch, our sensitive tongues also make us the best tasters: DA 2.9.421a18–20 and PA 2.17.660a20–22.

in some form incorporated by Plato into his thought, and consequently transformed and disseminated through him. The third option was by far the newest of the three ideas. The concept of animals (and humans) not merely imitating but being *imitative* (μιμητικός) is Aristotle's innovation. This was more than the repurposing of a Platonic neologism. As we saw, the idea of being imitative plays an important role in his understanding of animal behavior and learning, and in his teleological explanations of the organs associated with hearing and vocalizing.

Additionally, Option C is the only option that would *not* provoke any disagreement within the Lyceum. A Peripatetic might argue that some animals have a "numerate nature" or even that one or two show deference to certain gods, but not even Strato could dispute the idea that humans are the *most* imitative. At the same time, while Aristotle almost certainly would have agreed that the *knowledge* of counting and the *recognition* of the gods were behaviors unique to humans, he is unlikely to have singled out either of these as the factor most responsible for making us more authoritative than the other animals.

Why, then, are these the Options that are on the table when there was a host of other traits that could have been considered? It is impossible to know what, if anything, the author intended by this range of choices. However, we can offer a few suggestions:

1. Inter-school contention: The first two options are considerably more Platonic or, in the case of Option B, possibly even Stoic. Option C, however, is staunchly Peripatetic. So this may echo an ongoing debate.
2. Intra-school contention: We have evidence that the facts underlying option A and possibly B were being actively scrutinized if not debated by members of the Early Lyceum. If, say, Eudemus, were the author, this might be precisely the reason they are on the table.⁸⁶
3. The objects of the respective kinds of cognition in A, B, and C correspond to Aristotle's three-fold division of subjects in ἐπιστήμη θεωρητική: mathematics, first philosophy (or theology), and natural science, respectively. The thought, then, might be that only man is even aware of the objects of the first two, but nevertheless it is the superior imitation and comprehension of natural bodies that makes the greatest difference.

86 An even more radical suggestion is that Options A and B were raised and then rejected not only because imitativeness is a more fundamental difference, but also because the author no longer regarded counting or belief in the gods as distinctly human activities!

Why πειστέον? Perhaps *Pr.* 30.6 is drawing on a very specific discussion. Often a particular πρόβλημα will raise a question about one or more claims that we can locate in extant works of Aristotle or Theophrastus.⁸⁷ In this respect they might have served both didactically as commentary or a kind of *quod libet* and scientifically as a form of research extending observations or knowledge already discovered. It is possible, then, that this problem is just such a question, referencing a now lost and so far unidentified Peripatetic work. But to claim this as a means of explaining why the question is framed in terms of πειστέον or why these particular answers have been suggested would only be buck-passing. We would have the very same questions, only now about a non-extant and possibly non-existent text.

We must take *Pr.* 30.6 in its own terms and work our way back from the answers to the meaning of the question. The answers were claims about the uniqueness of humankind among the animals made in terms of salient capacities that we possess and that they lack. The answers also differ in terms of whether they are domain specific knowledge (Options A and B) or a generic capacity for acquiring knowledge (Option C). The first two seem to appeal to the special dignity or indispensability of their own type of knowledge to prove their relevance to being πειστέον. This suggests that πειστέον is authority in the sense of epistemic or moral authority.

The third option uses the form of reasoning that humans are *more* πειστέον than all the other animals because they are *more* X than all the other animals. Built into the question is the idea that this is actually a quality that animals possess to some degree. Of course, X cannot be just anything. We saw that the ability to learn and to teach (hence to be obeyed) vary in tandem across the species. Being most able to learn means being most able to teach, and if instruction is roughly what πειστέον is getting at, then being most imitative will imply being most capable of teaching.

If we combine these two senses, then we get something like the following: Why is that humans both *can* and *ought to* be listened to? The answer is that because they are better learners they are better teachers or instructors, and thus more authoritative; to learn, Aristotle reminds us, is to have knowledge.⁸⁸

I do not suppose that we will ever know for certain who the author of *Pr.* 30.6 is. But I believe we can constrain our speculation in a meaningful way by saying whom it could be by, and I think an adequate case can be made to show that it *could be* by Aristotle. Theophrastus and Eudemus were, of the

87 Foster (1927, vii), Mayhew (2011, 1: xxi).

88 Cf. ἔτι διδασκτὴ ἅπαντα ἐπιστήμη δοκεῖ εἶναι, καὶ τὸ ἐπιστητὸν μαθητὸν (*EN* 1139b25–26).

students of Aristotle, the two best known for their biological work.⁸⁹ We can hardly determine for certain what either Theophrastus' or Eudemus' full views were about animal minds, so we can hardly say that *Pr.* 30.6 is inconsistent with them. The doubts Eudemus or Theophrastus might raise concerning Options A or B is almost all that we have to go on for them. This could either count for their authorship, especially Eudemus', as per point 2, above. Or it could count against them, if we assume that the facts stipulated in all three options are granted by the author, with only the *explanatory* adequacy in dispute. At all events, Option C is probably more to theirs and every Peripatetic's liking and way of thinking.

One reason to slightly prefer Aristotle to them as a possible author—or merely to consider Aristotle a distinct possibility—is this: in the first generation of philosophers after Aristotle, the terms of the debates concerning animal and human differences were much clearer. The various issues all became bullet points under the general heading of: 'Animals: *rational* or not?'. Whatever reservations they may have had about this, it was Aristotle's students, not Aristotle, who referred to animals generically as "ἄλογα". And in that context *Pr.* 30.6 seems to beat around the bush. One can speculate that the debate could only reach such a point once the question had been asked already: Which of our *numerous* distinct features makes humans preeminent among animals?⁹⁰

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89 See Theophrastus frs. 350–83 FHS&G, and his brief extant work *On Fish*, and Eudemus frs. 125–32 Wehrli.

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‘ProblematISING’ the *Problemata*: The *Problemata* in Relation to Other Question-and-Answer Texts

Liba Taub

Posing questions and offering answers is central to several types of ancient literature, including the so-called problem texts, as exemplified by the *Problemata*. Christian Jacob has suggested that the *Physical Problems* attributed to Aristotle are probably the most representative text of the genre.¹ Such works follow a basic pattern in which a question is posed, often in a rather detailed fashion and, typically, at least one answer is provided. The genre of “problem” literature was impressively long-lived, extending well into the medieval and early modern periods.² During this long life, the genre of “problem” literature was not static, apparently serving various audiences with various purposes. Looking at the history of editions, Ann Blair has studied the learned version of the early modern period—promulgated in folio Latin editions with commentary on the text—as well as inexpensive “popular” editions in a number of vernacular languages. Pointing to the possible appeal of problem texts, she argues that “this eminently versatile genre offered its readers of all levels the satisfaction of a causal understanding of daily phenomena and the pleasure of a varied accumulation of natural philosophical tidbits.” A good portion of this appeal, she argues, was based on the focus of problem texts on everyday puzzles and issues, rather than on theoretical questions. Yet, in her view, the genre of *problemata* was linked to a particular philosophical approach to explanation, understood as having been “built around an Aristotelian conception of philosophical knowledge as causal knowledge, applied to the explanation of ordinary rather than specialist or abstract questions.” In later periods, the genre included “many editions and translations of ancient *problemata* as well as modern contributions, published separately and in conjunction with the ‘Problems of Aristotle.’”³

1 Jacob (2004, 41).

2 Lawn (1963), Blair (1999). Blair regards medieval and early modern problem literature as a sub-genre of question-and-answer texts (Blair 1999, 171).

3 Blair (1999, 172–73).

In the General Introduction to his new edition and translation of the *Problemata* or *Problems*, which he reminds us is the third-longest text in the Aristotelian corpus, Robert Mayhew muses that “surprisingly little can be said about the purpose and methodology” of the text. Nevertheless, while calling for more work to be done, Mayhew offers some observations about the nature of the text. First of all, he notes that the purpose is to raise questions about various Peripatetic philosophical and scientific works, and various medical (including Hippocratic) texts, as well as reputable opinions (*endoxa*) on a range of topics. He argues that, given the random and repetitive character of the compilation of questions-and-answers, the problems “clearly were not *organized* with a view to any purpose or to achieve any specific methodological goals.” However, as he emphasises, “virtually all” of the questions begin by asking “why”; the questions probe and seek the cause of things, the “on account of what”; very often it is a material explanation which is sought, with—perhaps surprisingly—very few teleological questions about purpose or aim.⁴

Here, the *Problemata* will be considered in relation to other ancient question-and-answer texts, with a view, too, to examining its relationship to other Peripatetic texts and modes of inquiry. I approach the *Problemata*, and other question-and-answer texts, as a specific genre, and consider questions related to issues such as form, function, and intended audience; I am aiming to “problematised” our understanding of problem literature, for I believe that our conception of these texts invites further work. As with some of the examples in the *Problemata* itself, in response to some questions—such as “what is the function of these texts?,” “why were they written/collected/compiled?” and “who are they directed towards?”—it seems unlikely that one single answer or solution will offer an adequate account of these texts. Rather, the multiple explanations that can be offered may help to account for the character and the format of the work, as well as its longevity in different historical contexts. In other words, these texts did not necessarily always assume the same function or appeal to the same type of audience, enjoying a degree of flexibility and variety in their use. The role and function of the “questions” is important; while some scholars have also argued that the list of questions-and-answers are catechistical, and a form of school-exercise,⁵ it is possible that in some

4 Mayhew (2011, 1: xxi; xxii–xxiii). See also the essay by Byron Stoyles in this volume, concerning material and teleological explanation in *Pr.* 10.

5 Morgan (1998, 80) suggests that there are so few surviving catechistical texts (a couple relating to characters in Homer, and a small number relating to grammatical rules as well as gnomic sayings) that it does not seem likely that they played a big role in education as an institution. Cribiore (2001, 209) describes *erōtēmata* (“questions”) as being a late development, occurring

cases they represent research agendas. One of the questions I would like to raise is whether these “question-and-answer” texts served a special function: to help individuals identify themselves, both personally and as part of a larger group (which may include people no longer living) as: “I am one of those who tries to answer these questions.”

My aim here, in problematising the *Problemata*, is to offer some suggestions to encourage further study of these intriguing texts. In what follows, I offer a brief discussion of the genre of “question-and-answer” or “problem” texts. It is helpful to consider possible settings in which they might have been compiled/read/discussed/used, and for what purposes. These might include: as symposiac literature, as a sort of “archive” of research ideas and interests, and as a sort of encyclopaedic literature.⁶

1 “Question-and-Answer” and “Problem” Texts: Genres and Sub-genres

There appear to have been a number of different “genres” (or “sub-genres”) of question-and-answer texts in Greco-Roman antiquity. Several terms are applied to these, even though the boundaries may not be entirely clear; in addition to *problemata*, *aitiai* and *zetemata* are two other terms that are encountered in ancient texts, as well as *aporemata*. Shades of meaning between the terms *problema* and *zetema* were not always clearly marked, particularly in the Hellenistic period, and these words, along with *aporema*, may function synonymously.⁷ Indeed, George M.W. Harrison (2000, 194 n. 3), writing specifically about Plutarch’s use of such terms, suggested that even though Plutarch

in grammatical texts of late antiquity and the Middle Ages, and being derived from pedagogical methods. It is not clear what role they played in rhetorical training.

6 Louis (1991, xxx) suggests that the *Problems* is an encyclopaedic work; this is a point which should be explored further. It is often used in relation to writings which function as reference works, encompassing a range of knowledge. The use of the term “encyclopaedic” has been debated. Enk (1970, 383) suggested that in Greece “the sophists were the first who claimed to impart to pupils all the knowledge they might want in daily life,” but that, nevertheless, “notwithstanding the value the Greeks attached to [what we might term] encyclopaedic knowledge, they never got so far as to compose an encyclopaedia.” Rather, by Enk’s interpretation, “it was reserved for the practical-minded Romans to lay down in a compilation the results attained by the scientific researches of the Greeks”; he has in mind works such as Pliny’s *Natural History*. On encyclopaedism, in antiquity and later, see Doody (2010), especially 11–23. See also Taub (2016, forthcoming).

7 Cf. Gärtner (2010, 914). Aristotle’s *Homeric Problems* is variously called Ἀπορημάτων Ὀμηρικῶν (D.L. 5.26 and *Vita Hesychii*), Προβλημάτων Ὀμηρικῶν (*Vita Hesychii*), Ὀμηρικὰ ζητήματα (*Vita*

appears to have intended to mark out distinctions between these genres, “perfect consistency is illusory”; even Plutarch himself occasionally mixed the terms.

2 Problem Texts

There are many types of texts which present questions (or “problems”) and answers (or “solutions”). The “socratic” dialogues of Plato often centre on questions and answers, presented in a distinctive, almost narrative, format. Mathematical proofs (a particular type of text),⁸ pose a problem and then offer a solution. Here, I will consider those texts which are mainly (if not solely) comprised of questions, sometimes with answers, such as the *problemata* texts included in the Aristotelian corpus.

Such “question-and-answer” or “problem” texts follow a basic pattern in which a specific question is posed, often in a rather detailed fashion, and answers are provided; in some cases a single answer is offered, in others a number of possible answers. These answers may range from rather brief (a few lines) to somewhat lengthy (the equivalent of several modern pages). Questions are not necessarily related to one another, although in some cases questions on similar topics are grouped together (as is the case in the *Problemata*).

As a compilation of numerous question-and-answer texts, the *Problemata* is by no means unique: there survive a number of collections of “questions” or “problems” which were posed and answered (or solved). Only fragments of Aristotle’s *Homeric Questions* survive; other texts emphasising questions-and-answers include Seneca’s *Natural Questions* (*Quaestiones naturales*) and Plutarch’s *Platonic Questions* (*Platonika zetemata* = *Moralia* 999c–1011e).⁹ Seneca’s *Natural Questions*, concerned with meteorological phenomena, may be regarded, to some extent, as natural philosophical, though it should be noted

Aristotelis Marciana), τὰ Ὁμήρου προβλήματα (*Vita Aristotelis Vulgata*), and *Homeric commenta* (*Aristotelis Vita Latina*), though these all almost certainly refer to the same work.

8 There is an argument for suggesting that certain logical and mathematical texts (for example, geometrical propositions and proofs) can be understood as related to question-and-answer texts; in certain geometrical texts, for example the *Elements* of Euclid, problems are presented and solved. (Intriguingly, like the *Problemata*, the *Elements* is usually regarded as a compilation; the *Elements* may have been collected by Euclid (between 325 and 250 BCE).) Gärtner (2010, 913) briefly comments on relevant terminology.

9 See also Plutarch’s *Roman Questions* (*Aitia Rōmaika* = *Moralia* 263d–291c) and *Table Talk* (*Symposiakōn Problēmātōn* = *Moralia* 612c–748d).

that there is a strong ethical and moralistic component as well.¹⁰ Some of the “Platonic” questions that Plutarch examines are natural-philosophical, while others are concerned with mathematical topics.¹¹ Questions and answers were recorded and transmitted on non-philosophical topics as well, including—importantly—literary questions. Some of the so-called *zetemata* literature deals with the Homeric poems, examining, for example, the meanings of particular expressions.¹² Significant portions of the pseudo-Aristotelian *Mechanics* (or *Problemata mechanica*), perhaps the earliest surviving text on the subject,¹³ are also presented in a question-and-answer format.

The *problemata* texts, as a genre, reflect interactions between oral and written culture; the texts are collections of “problems,” or “questions and answers,” in which problems and questions are posed and answered. The word *problēma* refers to something thrown forward or projecting; Liddell-Scott-Jones (s.v. πρόβλημα, 2) also points to a meaning indicating a “hindrance” or “obstacle.” Harrison (2000, 195) has suggested that the noun *problema* (from the verb *proballō*) “by its etymology means to ‘throw forward’; as in ‘throwing forward an idea for discussion,’ rather like the Latin *propono*, if perhaps a bit stronger.” This meaning of “getting something out there” seems particularly important for giving clues to the intended use of the question or problem texts: these may be intended as research questions. Like an *aporia*, a *problema* is a difficulty or obstacle; the term *problema* may carry a dual meaning, indicating that the difficulty is being projected forward for discussion.¹⁴

3 Addressing Difficulties (*aporiai*)

Within the context of ancient Greek philosophy, the consideration of an *aporia* (a difficulty, question, or puzzle) characterises the style of philosophizing that originates in a difficulty, question, or puzzle being raised for discussion; indeed, this type of philosophizing is sometimes called “aporetic” by

10 See now Williams (2012, chapter 2).

11 Harrison (2000, 195) has argued that Plutarch set out to innovate with regard to the genres of questions-and-answers.

12 For example, Heraclitus, *Homeric Problems* (extant) and Porphyry’s *Homeric Questions*. The first book of Porphyry’s *Homeric Questions on the Iliad* is extant in one manuscript (Vat. gr. 305). For the rest, extracts from Porphyry’s *Homeric Questions* (on the *Iliad* and the *Odyssey*) have survived among the Homeric scholia.

13 Berryman (2009, 106).

14 I thank Robert Mayhew (personal communication) for sharing his thoughts on this.

philosophers. The role of *aporiai* in philosophy is crucial; according to Aristotle (*Metaphysics* A.2.982b14–20), philosophy—as well as myth—is a response to wonder (*thauma*), arising from a difficulty (*aporia*).¹⁵ With regard to the *aporiai*, Aristotle explains that:

for those who wish to get clear of difficulties [for example, philosophers] it is advantageous to state the difficulties well; for the subsequent free play of thought implies the solution of the previous difficulties, and it is not possible to untie a knot which one does not know. . . . Therefore one should have surveyed all the difficulties beforehand, both for the reasons we have stated and because people who inquire without first stating the difficulties are like those who do not know where they have to go.¹⁶

For Aristotle, philosophy begins with the identification of *aporiai*, of difficulties and problems;¹⁷ the metaphor of the untying or loosening (Greek = *lusein*) of the knot points to the work that must be done. Recognising what Hans Gärtner refers to as the “functional proximity” of *aporiai*, *problemata*, and *zetemata*, solutions (*luseis*) can be understood as the goal of all of these.¹⁸

Aristotle regarded “difficulties” (*aporiai*) as a way into philosophy, and during his time at Plato’s Academy, he is understood to have compiled notes on various examples that intrigued him.¹⁹ But as we know from the scope of subjects covered in his writings, Aristotle was attracted not only to philosophical issues, but to a wide range of topics. The *Poetics* attests to his interest in the literary, as do the thirty-eight quotations (which survive today, mainly in Porphyry’s *Homeric Questions*) from what was apparently his collection of difficulties in Homeric interpretation, eventually published in six books (variously referred to by ancient authors as *Aporemata homerika*, *Ta homerou problemata* and *Homerika zetemata*).²⁰ Rudolf Pfeiffer has suggested that “probably over a long period of time” Aristotle had “drawn up for his lectures a list of ‘difficulties’ of interpretation in Homer with their respective ‘solution,’” noting that the empirical research required by Aristotle for this work “was done

15 Cf. Peters (1967, 22–23).

16 Arist. *Metaph.* B.1.995a27–36; trans. Ross, in *Complete Works*, 2: 1572–1573.

17 Cf. Arist. *Metaph.* B.1.996a6.

18 Gärtner (2010, 914).

19 Jacob (2004, 44). See also Louis (1991, xxviii–xxix), who cites E. Egger (1850, 128–34), *Essai sur l’histoire de la critique chez les Grecs, suivi de la Poétique d’Aristote et d’extraits de ses Problèmes avec traduction française et Commentaire*, Paris: A. Durand.

20 Pfeiffer (1968/1978, 69).

with great care; Aristotle seems to have taken immense trouble to solve numerous problems of the Homeric poems, some of which had been discussed for two centuries."²¹ In line with this, Chapter 25 of Aristotle's *Poetics* opens with a reference to "problems" (*problemata*) and their solutions (*luseis*), specifically, problems or difficulties in the epic poets.²² This way of shaping textual questions persisted; Nünlist (2009, 11) has noted that, more generally scholia often take the form of " 'question and answer': for example, 'why is it that (διὰ τί) . . . ? Answer/solution (λύσις): because (ὅτι) . . . ' or the like," suggesting that this practice goes back to Aristotle himself. The collecting activity that resulted in his *Homeric Questions* was not dissimilar to the sort of data collection that Aristotle undertook in other spheres, including his own empirical research on living organisms. Furthermore, he involved others in his collecting activities; he was responsible for assembling a collection of the constitutions of city-states, a collection that informed his work on politics, as well as—apparently—proverbs and popular sayings.²³

4 The Pseudo-Aristotelian *Problemata*

The compiling of a collection of difficulties and problems resonates with other aspects of Aristotle's activities, including the collecting of proverbs, as well as his suggestions for taking reading notes and making lists of opinions. Aristotle's collection of problems (*aporiai*) was available to members of the Lyceum. Over time, a number of Peripatetic philosophers added to the collection.²⁴ Aristotle is known to have written a book of problems, and while there is scholarly agreement that the so-called Pseudo-Aristotelian *Problems* (*Problemata*) is not by Aristotle himself, Robert Mayhew (2011, xxi) has plausibly suggested that

²¹ Pfeiffer (1968/1978, 69). Differently, see Breitenberger (2006, 305–21 and 369–430).

²² Chapter 25 is notoriously difficult, and scholars have debated its meaning. Else (1967, 111–12), ventured that "this section is not really a part of the fabric of the *Poetics*," suggesting that "it appears to be a compendium of material collected and published elsewhere and simply tacked on here, possibly by a later redactor, as an appendix, to Aristotle's discussion." See also Janko (1987, 145) on *Poetics* chapter 25 and the "problemata" related to *Homeric Problems*.

²³ See [Aristotle] *Athenaion Politeia*. Natali (2013, 97–98) also discusses Aristotle's collecting of opinions and of proverbs and popular sayings (25–26). He mentions Athenaeus (2.60d–e), noting that Cephisodorus criticised Aristotle for collecting proverbs (testimonium 63d).

²⁴ Louis (1991, 1: xxiii–xxxv; cf. Mayhew (2011, 1: xxi). See also Natali (2013, 117), who treats the doxographical lists as a type of visual aid useful for teaching, along with diagrams, maps and anatomical illustrations.

Aristotle began the work we now have, but that over the years (and after his death) others added and subtracted from it. The work was apparently compiled over a period of time and may not have reached its present form before the fifth century CE; in other words, it may not be the work of one individual, but many. Having said that, some of the material included in the *Problems* seems actually to have its source in the work of Aristotle; several ancient authors (including Plutarch and Cicero) described portions of the *Problems* as Aristotelian.²⁵

The work is composed of thirty-eight books, covering a wide range of subjects, from problems connected with medicine, to problems associated with justice and injustice. The thirty-eight books of the work contain nearly 900 questions, organised by topic.²⁶ Book 1 deals with problems connected with medicine; we find problems concerned with mathematics (Book 15), problems with shrubs and plants (Book 20). Several of the books are particularly concerned with problems related to meteorological phenomena; Book 25 deals with air and Book 26 with wind.

The problems are posed in a particular fashion; many begin with the question: "Why?"²⁷ Furthermore, the answers offered are (always? usually?) in the form of a question: "Is it because . . .?" Here is question 9 from Book 25, concerned with air:

Why does air, which is thicker than light, pass through solid things? Is it because light travels only in a straight line, and this is why sight cannot see through porous things, like a pumice stone? For the passages overlap; but they do not in the case of glass. But air is not hindered, because it does not go straight through that which it passes.²⁸

This is the sort of question we can imagine being answered by one of the *physikoi*. The rather mundane character of many of the questions, often (but

25 Hett (1936, 1: vii–viii). Cf. also Louis (1991, 1: xxviii–xxix); Mayhew (2011, 1: xx–xxi); Flashar (1962, 308).

26 Cf. Forster (1928, 163).

27 In the *APo.* 2.1.89b24–35, Aristotle had explained that there are four main types of question to be posed in an investigation: the "that" (or, the "fact"), the "why" (the reason why), if it exists, and what it is. The form of the questions posed in the *Problems* is an enquiry of the second type. See Mansfeld (1992, 70–71). Cf. Barnes (1984, 1: 147).

28 *Pr.* 25.9.939a10–15, trans. Mayhew (2011, 2: 145).

not only) focusing on familiar, everyday occurrences, has resonance with the Aristotelian explanatory tactic which depends upon use of analogy.²⁹

Thinking about individual problems in the *Problemata*, it is also worthwhile to consider their relation to other types of problems and puzzles, including those which may be classified as philosophical problems, puzzles for symposia, and even mathematical problems. Indeed, Book 15 of the *Problemata* deals with questions concerning mathematics and celestial matters, for example, question 10:

Why are the shadows from the Moon longer than those from the Sun, when (*the shadows*) are from the same perpendicular object? Is it because the Sun is higher than the Moon? The ray from the higher body must, therefore, fall inside (*the ray from the lower*). A gnomon is where $A\Delta$ is, the Moon is B and the Sun is Γ . The ray from the Moon, then, is BZ, so that ΔZ will be its shadow; but the ray from the Sun is ΓE , so that its shadow will necessarily be shorter, for ΔE , will be its shadow.³⁰

Here, a question arising from observation—the length of shadows—is answered by means of a geometrical demonstration.³¹ Many mathematical texts (for example geometrical propositions and proofs) can be understood as related to question-and-answer texts; in certain geometrical texts, for example Euclid's *Elements*, problems are presented and solved. There is no distinct genre of “mathematical text” in antiquity; those authors writing about mathematics used a variety of formats, including some that look similar to question-and-answer texts.³²

The question-and-answer format reflects both some subtleties and complications in terms of format and presentation of individual problems, suggesting a degree of liminality between oral and written discourse. Given that the *Problemata* is composed not simply of individual problems, but is a number of collections of question-and-answer texts grouped into “books,” a consideration not simply of the form and function of individual problems, but also

29 Lloyd (1966, 193); Taub (2003, chapter 3).

30 *Pr.* 15.10.912b4–10, trans. Mayhew (2011, 1: 471).

31 The question concerns the shadows cast by the sun and moon. A geometrical demonstration is used to present an argument about phenomena. Mayhew (2012, 182–83) has suggested that Book 15 may contain “remnants” of what were at some point two separate sets of problems, one concerned with more general mathematics, the other focused on astronomy.

32 Taub (2013, 341).

of the function of individual books and, indeed, the whole collection, would be desirable.

The written format of the text is important, and raises numerous questions regarding the ways in which the text was used. An enormous range of topics is addressed in the individual books of the *Problemata*. How were individual books used? Was the entire *Problemata* copied, or were individual books, on specific topics, chosen by users? We know that individual books of Pliny the Elder's *Natural History* could be copied as desired by readers/users; is there any evidence of a similar practice with the *Problems*?³³ One can imagine that some books would have been deemed particularly useful for teaching; what other functions did the books serve? It is possible that the books served "archival" functions, allowing—even encouraging—the recording of ideas and approaches to solving particular types of problems and questions.³⁴ The problem texts should also be considered with regards to the so-called doxographical literature, in which *doxai* (opinions) are reported and organised for use in philosophical argument.³⁵

Then there is the question of the entire *Problemata*, as a collection not only of individual question-and-answer texts, but as a collection of collections of such texts, into "themed" books. What is the purpose of such a wide-ranging collection of question-and-answer texts? What other collections of questions were compiled? Are there any parallel collections, covering such a variety of subjects? Blair has argued that the *Problemata* represents an encyclopaedic inquiry,³⁶ suggesting that this was part of the appeal of the collection as a whole. These questions, while intriguing, cannot all be addressed here; nevertheless, they are worth raising. A consideration of the *Problemata* with regard to other texts that are in various ways somewhat similar to it is useful as a first

33 Cf. Gell. 2.30.11, "This too has been observed by the most experienced philosophers of nature, that when the south winds blow the sea becomes bright and blue, [when] the north winds [blow the sea becomes] dimmer and blacker. I noted the cause of this when making excerpts from Aristotle's books of problems (*Aristotelis libros problematorum*)."

I thank Robert Mayhew for this example.

István Bodnár (personal communication) has pointed to the additional question as to whether or not such excerpts would have been intended mainly for personal use, or would have been circulated to others. I thank him for raising this and other insightful points with me.

34 Gärtner (2010, 913–14) notes that the term *zetema* was used as a *terminus technicus* for philosophical research questions that require solutions.

35 Diels (1879).

36 Blair (1999, 171).

step; with that in mind, we turn our attention to so-called *zetemata* and doxographical texts.

5 *Zetemata*

Mathematics provides special sorts of problem-texts, which may be regarded as technical. Other problem texts focused on literary works, especially epic, and also relied on a type of technical knowledge and, in a somewhat similar way, seem to have offered opportunities for a display of ingenuity—even virtuosity—in the solutions offered. The term *zetema* is related to the verb *zetein* (“to search”): a *zetema* is the focus of a search or investigation; the impulse for conducting a search may be an *aporia* or a *problema*.³⁷ For some authors and readers, the term *zetemata* appears to have been used in a “quasi-technical” sense for problems or questions concerning the meaning of expressions in the Homeric poems, as well as passages in other texts, and individual statements or opinions or incidents.³⁸ Harrison has explained that the term *zetemata* originally seems to have been used in the context of the exegesis of difficult literary passages, especially in Homer but in other poets as well. However, the term was not restricted to literary studies: that the nature of the specific inquiry was drawn out while confined to a single issue is shown through its frequent application to legal proceedings, for example, in papyri, and inscriptions. He has suggested that the term *zetema* “seems to have been assigned a technical philosophical meaning to describe a search or inquiry” about abstract notions or qualities, such as “the gods” (*ta theia*) (as in Xenophon *Memorabilia* 1.1.15), or “virtue” (*arete*) (as in Plato’s *Meno* 79d). By his reading, it was Plutarch’s “archaizing innovation” to bring the term back to an earlier sense, referring to the consideration of a tightly-defined query (as in the study of passages in Homer). In Plutarch’s case, the query was usually one of a philosophical nature, one that “normally required a long development yet did not necessarily admit of a finite answer agreeable to all parties.”³⁹ Thus, for some authors and readers the term *zetemata* was not restricted to literary questions, but might include specific questions on other topics, for example, as part of the study of philosophy or nature, and of scientific research.

37 Gärtner (2010, 914).

38 Cherniss (1976, 2–5), in his “Introduction” to Plutarch’s *Platonic Questions*, discusses the so-called *zetemata* literature.

39 Harrison (2000, 195). Cf. König (2007) and Opsomer (2013) on Plutarch and questions.

In the case of Plutarch's *Platonic Questions*, we have ten separate *zetemata*, each concerned with the meaning of a passage or of apparently related texts in Plato, but unconnected with one another, and without any general introduction or conclusion to give the collection unity or to suggest a reason for the sequence of ordering these *zetemata*. Several of the Platonic questions that Plutarch examines are focused on mathematical and natural philosophical issues, for example question 6:

In what sense does Plato say that, because there is void nowhere, the cyclical replacement of motion is the cause of what happens in the case of medical cupping-instruments and in that of swallowing and of weights that are thrown and of flowing waters and of thunderbolts and of the apparent attraction to amber and the loadstone and of the consonances of sounds? For he would seem in extraordinary fashion to be proposing a <single> cause as the source of numerous and dissimilar occurrences.⁴⁰

Intriguingly, Plutarch makes it clear that he was not the first to pose questions about these particular passages; he discusses and refers to answers other than those which he offers as his own. (In this way, the presentation is somewhat similar to Aristotle's treatment of the *doxai* [opinions] on problems or questions posed in his writings; this similarity will be revisited below.)

Harold Cherniss noted that *zetemata* dealt with problems for which the solutions suggested might be made available to interested readers in various forms. One such format might be called "notes" (*hypomnemata*); another is that of the literary "symposium."⁴¹ The latter was an entirely appropriate literary frame in which to present questions and answers, since in intellectual circles problems and puzzles were proposed for discussion by the company after dinner. Athenaeus' third century *Deipnosophistai* (*The Learned Banqueters*) is a particularly rich exemplar. Pfeiffer suggests that *zetemata* were actually part of symposiac culture: the custom of *zetemata proballein* (throwing out or putting forward questions) "may have prospered at the symposia of intellectual circles."⁴² It is also possible to contrast "the give-and-take of

⁴⁰ Plut. *Platonic Questions* 6.1.1004d–e. Trans. Cherniss (1976, 63–65).

⁴¹ Cherniss (1976, 2–3).

⁴² Pfeiffer (1968/1978, 69). But note Blank and Dyke (1984, 23), criticising Slater (1982, 346–48): "There is, then, no reason to suppose that the great Alexandrians regarded the solving of philological problems as somehow connected with symposia. Symposiastic conversation in Ptolemaic Alexandria will have contained discussion of some *zetemata*, but it is unlikely to have contained all such discussion. . . . Not all problem-solving, let alone all

sympotic literature” versus the seemingly “more straightforward question-and-answer format of *aitiai*”.⁴³ Multiple answers are common both to sympotic and to question-and-answer texts. Certainly, sympotic literature gives voices and perspectives to the different views presented: “this sort of person offers this sort of solution.”⁴⁴

Plutarch himself in his *Symposiacs* uses the term *zetemata* of the questions or problems propounded and discussed there—several of these, without their literary embellishment, could have been included in his *Platonic Questions*. Similarly, as Cherniss notes (1976, 3), the material from the *Platonic Questions* could have been incorporated in the *Symposiacs*. There is a question whether or not *zetemata* texts are fundamentally different from *problemata* texts, or merely a variant type.

6 “Problem Texts” in Relation to Doxographical Texts

And, strikingly, in the Aristotelian *Problemata* the individual problems themselves presented therein display no authority instilled in the text itself: the problems are almost completely anonymous.⁴⁵ Yet, as has already been noted, to some extent question-and-answer texts are reminiscent of doxographical texts, in which a number of opinions (as potential “answers”) are provided. Remember that in his other works, Aristotle often provided a number of opinions (*endoxa*) on any given topic. Indeed, in the *Topics* (104a9–35), he explained that starting from opinion was an important feature of dialectic.⁴⁶ In addition to starting from others’ opinions, another characteristic of dialectic (and also of philosophical dialogue) is the question-and-answer format. It is

the work of the Alexandrian scholars, is to be viewed with the symposium in mind.” (Cf. Jacob 2004, 47: 51)

43 Harrison (2000, 194 n. 3).

44 Aude Doody (personal communication) has suggested that, perhaps, the dramatisation of debate is already implicit in *zetemata*.

45 Jacob (2004, 41–42). Aristotle himself refers to the *Problemata*, but almost always it is difficult to connect with the extant work. The ancient lists (those of Diogenes Laertius and “Hesychius,” at any rate) likely come from the Hellenistic period. By the time of Diogenes Laertius 5.26, *Problemata* are ascribed to Aristotle, a tradition no doubt stemming from the Hellenistic period. The reference in Diogenes Laertius to a work known as the *Physica* (*Physica*) in thirty-eight books suggests that this is our *Problemata*, which has the same number of books; see also Menn, in this volume, on this point. Diogenes Laertius mentions other “problem”-type works ascribed to Aristotle, including the *Mechanics*.

46 Cf. Smith (1997, xiii–xiv). See also Mansfeld and Runia (2009) 2.1.158–61.

this question-and-answer format that distinguishes dialectical argument from other kinds of argumentation.⁴⁷ Socrates, as portrayed in Plato's dialogues, had earlier used opinions as the starting-points for argument and investigation. The *Problemata* and Plutarch's *Platonic Questions* provide examples of different opinions (or "answers") on particular questions. Seneca's *Natural Questions*, might be considered as some sort of variant on a question-and-answer text and, to some extent, it may be regarded as doxographical. Many of the *doxai* would have been recognised as being associated with particular individuals or philosophical schools. It is easy to imagine that the questions posed might well reflect opinions, *endoxa*, and so be related to doxographical texts, in which opinions are collected and recorded. Doxographical texts can also be understood as preserving or archiving earlier ideas, and might be organised as lists, or even tables, of various opinions on specific topics and questions.⁴⁸ (The coinage "doxography" dates to the nineteenth century, and posits a literary format which is now—apparently—lost, even though "traces" survive in other works; there are references to what appears to have been the practice of compiling lists of opinions.⁴⁹) Surviving textual evidence (including references to now-lost texts) reflects a number of activities involved in producing and using these texts which served an archival function, allowing storage, with a view to future retrieval; these activities contribute to the processes of archiving and accessing the information contained therein.

In much of his discussion of dialectic, Aristotle seems to be operating within the framework of oral argument, especially when one remembers that dialectical argument may be useful for *casual* encounters. However, he makes it clear (*Topics* 1.14.105b13) that he is also working within a culture of the "book," a culture of both reading and writing. He suggests that "we should select also from the written handbooks of argument, and should draw up sketch-lists [*diagraphai*; Smith trans. = "tables"; cf. *EE* 3.1.1228a28] of them upon each several kind of subject, putting them down under separate headings." Here, one can imagine ordered lists, or tables as Smith suggests, organised by headings, such as "good" or "animal."⁵⁰ The lists or tables allow the classification of various

47 Dialectical argument can be distinguished from sophistical (or contentious) argument. Cf. Smith (1997, xv).

48 On doxography, see Mansfeld (1986/1990; 1992; 2002; 2012); Mansfeld and Runia (1997); Runia (1999, 46); Meyer (2006). In addition to lists of *doxai*, doxographical literature may include other formats of text; cf. Fischer (2013).

49 Diels (1879).

50 Smith (1997, xxiii–xxiv). See also Natali (2013, chapter 3).

endoxa by subject, thereby allowing ease of reference when required. This can, I would argue, be understood as a form of "archiving."⁵¹

The collection of opinions as part of the method of philosophising was central to the aim and function of doxographical texts. In Aristotle's writings on physics, it is clearly a fundamental part of the tactics in these works, including the *Physics*, *On the Heavens*, and the *Meteorology*, to survey the views of others, especially "the wise." Cynthia Freeland has argued persuasively that Aristotle's discussion of the *endoxa* presents a picture of natural philosophy as a "problem-solving activity," in which important questions and problems are highlighted.⁵² Questions and problems may arise from the process of critical examination of the *endoxa*, apart from the phenomena themselves. So, for example, Aristotle rejects Anaxagoras' explanation of hail, in which clouds are forced by the summer heat to the upper region, where the water in them freezes. He cites evidence, based on observations, to refute the explanation: Aristotle points out that hail falls from clouds close to the earth, rather than from far above, contradicting Anaxagoras' opinion on the matter.⁵³ In this way, doxographical and problem-solving texts play synergistic roles in Aristotle's philosophical practice.

7 Written Form of the Problem Texts as Archive?

As it stands, the genre of problem texts reminds us of the oral nature of ancient discourse, and the various literary forms that reflect orality. One of the challenges of oral discourse was to remember: the role of memory in oral composition and transmission of poetry, for example, is a big topic outside the scope of this essay; nevertheless, some have argued (and experienced) that written formats can serve as aids to (or even replacements for) memory. The notion that a literary (written) text may serve to preserve—as well as present—information and ideas is important here.⁵⁴

51 Arist. *Top.* 1.14.105b12–17, trans. W.A. Pickard-Cambridge, in *Complete Works*, 175. Aristotle also instructs that "in the margin, too, one should indicate also the opinions of individual thinkers, e.g. that Empedocles said that the elements of bodies were four," indicating the desirability of active involvement by the reader with the text. (On Aristotle's reputation as a reader, see Althoff (1999, 94 n. 94) and Düring (1957, 98 and 337 ff.)).

52 Freeland (1990, 79).

53 Freeland (1990, 79). Arist. *Mete.* 1.12.348a14–30.

54 Cf. Small (1997, 240).

The vocabulary used to describe dealing with *problemata* and *zetemata*, as well as *aporiai*, vividly connotes activity. Significantly, the presentation of questions and answers is characteristic of several styles of ancient Greek and Roman philosophical discourse, including dialectical argument and dialogue. Notably, the questions and answers presented in the Aristotelian *Problems* are not presented as part of a conversation, discussion or debate (as in, for example, Plutarch's dialogue *On the Face of the Moon*). There is no social interaction or background alluded to in the text itself, as we might expect in symposiac literature. Yet, clearly, the material presented in collections of questions-and-answers, like the *Problems*, could have been offered in other genres of texts very easily (for example, dialogues), without much difference in their format; typically, in dialogues, a question is posed and an answer (or two) proffered. The presentation of questions-and-answers in a "stripped-down," "bare bones" format, devoid of any of the contextualisation offered by a dialogic or symposiac text invites us to consider the possible motivations for this format. The presentation of question-and-answer texts as written lists or collections of questions-and-answers (some of which include lengthier, and more, answers than others) encourages us to think about the importance of that written format, and the possible functions of that format, for instance, perhaps as a sort of archival genre, a repository of interesting or perplexing questions, to be used in a range of activities, including teaching (of various subjects) and research.

Here, the "openness" of the genre of problem texts is significant,⁵⁵ for it allows—and possibly even encourages—the text to develop in the hands of readers, who then, in turn, may become subsequent authors, or alterers of the original text. The notion of "compiler" suggests that someone acted to collect questions together into one text; while that may have been the case, room should be made for understanding the role of active readers, who helped to change and alter an evolving text. As an example of an "open" genre, the problem text is actively engaged with, in a way not entirely dissimilar to another open genre, the commentary; new readers can put their own stamp on the text.

The format of the problem texts reflect the interchange of questions and answers associated with certain styles of philosophizing, as well as symposiac culture, suggestive of oral discourse. Yet, simultaneously, problem texts also suggest a certain concern with written formats, including lists, if not a certain "bookishness." Aristotle has been credited (for example, by Rudolf Pfeiffer as well as Jocelyn Penny Small) as having assembled "the first large private library."⁵⁶ This is an important clue that he valued the preservation and what

55 Jacob (2004, 43). See also Sluiter (2000, 191–92) on "open" and "closed" genres.

56 Pfeiffer (1968/1978, 67); Small (1997, 43–44).

might be posited as the relatively easy retrieval of information (while noting that the ease of handling papyrus rolls has been the subject of modern scholarly debate, and there are ancient anecdotes about the unwieldiness of rolls). Indeed, certain types or genres of texts, including lists and notes, as well as “problems,” may have been used to provide an archival capacity for Greeks and Romans interested in studying topics and issues in a range of fields, including physics, astronomy, mathematics and medicine.

Amongst the ancient Greeks and Romans, there were a number of seemingly special textual formats that were used to permit storage, organization, and retrieval of various sorts of information. For example, we have the records of astronomical data preserved in Ptolemy’s *Handy Tables* (Πρόχειροι κανόνες); Pliny the Elder presented another sort of “table,” a table of contents, as the *summarium* in Book One of the *Natural History* can be understood and used.⁵⁷ These completely different types of “tables” both provided the means to preserve, organise, transmit, and retrieve information important for what we today regard as scientific work (such as astronomy, astrology, agriculture, etc.), and the types of texts these “tables” represent persist into our own time; indeed, they are regarded as crucial components of many sorts of texts, not only the scientific.

Other types of texts useful for recording and retrieving all sorts of information appear to have been developed and used by ancient scholars, including, but not only, those engaged in natural philosophical work. We find in ancient texts references to and traces of what might be regarded as several different genres—which might almost be regarded as technologies—for organising and storing knowledge, ideas, research questions, data, various bits of information, observations, etc. Examples of some of these genres—including the *summarium* in Pliny’s *Natural History*, literary *paraepgmata*, etc.—survive in extant texts; in other cases, we have only fragmentary traces, and the accounts or reports of others (including references to diagrams, which no longer actually survive).⁵⁸

57 See Doody (2001) and Small (1997, 16–18) on Pliny’s table of contents.

58 On the *summarium*, see Doody (2001); on *paraepgmata*, see Taub (2003, chapter 2), Lehoux (2007, chapter 1); on diagrams (and whether what we find in later manuscripts relates to anything that existed earlier), see Saito (2006). On diagrams in Aristotle’s works, see now Natali (2013, 113–17).

8 An Archaeology of Texts

It is worth considering the possible relationships between “question-and-answer” texts (including *problemata* and *zetemata*) and other genres, for example, *hypomnemata* (notes) and doxographical texts preserving *doxai* (opinions or tenets). I propose a sort of archaeology of texts, to explore question-and-answer texts and other, possibly related, genres. I note that a somewhat similar approach was advocated by Jocelyn Penny Small, in her *Wax Tablets of the Mind: Cognitive Studies in Memory and Literacy in Classical Antiquity*.⁵⁹ She describes her approach as: “Look at what was produced and try to figure out why it is the way it is and what that implies for tasks that it was used for.”⁶⁰ In the case of question-and-answer texts, relevant issues include considering how the format of these texts may shed light on their creation and usage.

The genres of (collections of) question-and-answer text, doxographical text, and *hypomnema* appear to share several features with regards to the activities associated with their production, assemblage and use:

- the “open” nature of the text;
- the “empirical” research underlying the text;
- these texts often suggest or reflect activity and interaction (like dialogue or conversation), conducted in groups (for example, symposia);
- the process of compilation by a number of people over a period of time (for example, our *Problems* is reckoned to be a compilation over centuries, with many people having been involved);
- the publication (and shared nature) of these texts (i.e., they are not only for private consumption);
- these genres of texts seem to have all been intended to contribute to other intellectual projects (the results of which were often themselves communicated in written form);
- the preservation (and use) of these texts by other, later writers, indicating that they were regarded as worthy of continued interest and investment;
- the sense that these texts are part of a long-lived “tradition” (for example, of pointing to questions or problems and looking for and offering answers or solutions).

59 I am not exactly certain whether my approach is an example of what Small herself refers to as “anticipatory plagiarism,” referring to “those situations when a scholar thought of something totally independently, only to discover later that someone else had already thought of the same thing” Small (1997, 245, Preface, n. 1).

60 Small (1997, 240).

At least some of the compilations of questions-and-answers (including the *Problemata*) appear to have been part of a communal effort, in some cases, connected to a school—perhaps undertaken over a significant period of time—to identify intellectual problems and to offer solutions.⁶¹ There is evidence that activities involved in addressing such questions were sometimes done in group settings (e.g., symposia, and later, for example, through the reading of commentaries in group settings). Significantly, the format of the question-and-answer text was not unique to Greco-Roman antiquity, but appears in (and in some cases was transmitted to) other cultures and later periods.⁶²

Considering the *Problemata*, István Bodnár has pointed to what appears to be, from the “archaeological” standpoint I advocate, a tension between, for example, the open and shared nature of the work, produced as a compilation of problems devised and collected within a close-knit intellectual community, and its fixed and uniform character as a publication in antiquity. Because of this tension, we may regard the *Problemata* as a “fossilized end-result of an essentially open endeavor,” accomplished over a period of time. Indeed, the open nature of the genre is further indicated in the way that later works incorporated material from the published *Problemata*.⁶³ With this in mind, it is worth revisiting Blair’s work on problem texts in later periods. As she has noted, the genre included editions and translations of ancient *problemata*, in addition to more modern contributions, which were themselves “published separately and in conjunction with the ‘Problems of Aristotle.’”⁶⁴ This again points to the open nature of the problem literature: new problems are presented in later periods, while fresh ways to present the ancient material are developed, even as texts are edited, translated, published and, again, fixed.

More generally, question-and-answer texts may have served as important archives for the active researcher in a number of areas, including natural

61 For example, there are clear connections between three books of the *Problems* (2, 5, & 26) and three works of Theophrastus (*On Sweat, On Fatigue, On Winds*).

62 Niehoff (2011, 50); as Harrison (2000, 194, n. 3) notes, medieval and Renaissance scholiasts and commentators used the term *quaestiones* to cover a range of sub-genres.

63 Bodnár (personal communication). He points out that while we do not know the textual variants of the *Problemata* in antiquity, the number of books seems to have been fixed early on. I am grateful to him for sharing his suggestions and insights. Flashar (1962, 359–70) provides a detailed account of later ancient *problemata* collections, noting which contain material from the *Problemata*; he also discusses the *Problemata* in the medieval period, including Arabic and Latin translations (370–74).

64 Blair (1999, 172–73).

philosophy as well as medicine.⁶⁵ Significantly for our consideration of the archival character of question-and-answer texts, some of the observations in the *Problems* are also found in Aristotle's works,⁶⁶ suggesting that the collected questions and answers were used to produce more polished treatments.⁶⁷ The "problem" text is an archive of past (and present) research topics and questions; furthermore, the provision of potential answers (sometimes singly, sometimes as multiple possibilities) may provide an archive of research "progress."⁶⁸

As noted above, this genre of "question-and-answer text" is clearly related to other genres and styles of discourse, particularly the dialogue (including the symposiac literature) and the so-called doxographical literature. One possible function of the genre of the question-and-answer text is also to serve as an archive of active and interesting research problems. The archival function of the problem texts reinforces a link to doxographical lists; both were used as part of a philosophical method, involving the consulting of previous work in the field. Certainly, a list of previous questions asked and answers proposed could help shape further work.

The questions and answers of the *problemata* texts may be related, to some extent, to the dialogic form, and gesture towards oral exchange, while also sharing something of the compiling of the written lists associated with doxographical texts. In the case of both problem texts and doxography, the form of the genre was closely related to and in part determined by the philosophical methods being advocated. The links between these types of texts may be fundamentally related to argumentative and investigative methods.

One question explored here is whether it is fair to say that certain types or genres of texts (lists, notes (*hypomnemata*), "problems," etc.) provided an archival function, preserving records and texts relevant for research, for Greeks and Romans (and later readers and users) interested in studying topics and issues in a range of fields, including natural philosophy, astronomy, mathematics and medicine; the archival function permits a form for "storage" (in this case,

65 Natali (2013, 104–13) discusses methods of gathering and interpreting information at the Lyceum, but does not consider question-and-answer texts in this way.

66 For example, within Book 10 of the *Problemata*, nearly half of the chapters seem to have their source in, or otherwise some connection to, Aristotle's biological writings; cf. Mayhew (2011, 1: 279).

67 Mayhew (personal communication) has suggested that this may also indicate that students/ colleagues in the Lyceum were raising questions about the biological work being carried out by Aristotle and others.

68 "Progress" is typically regarded as a Stoic concept.

almost a form of list) as well as retrieval of information. The genre of “problem” or “question-and-answer” text is not particularly well-studied, yet may be important for our understanding of scholarly community and methods, and particularly for understanding how information is archived and accessed by those interested in scientific (including mathematical and medical) subjects.

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